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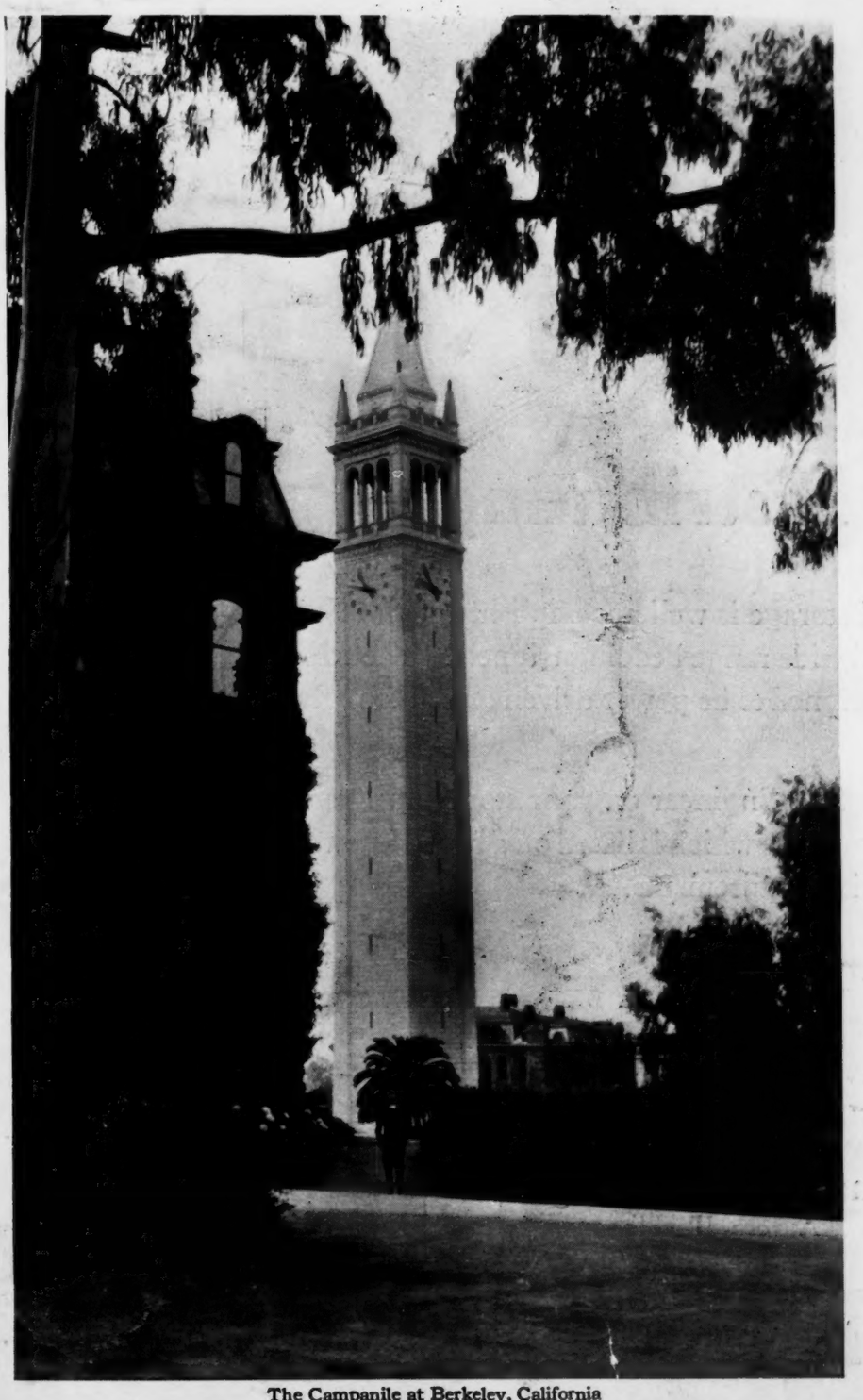
January 7, 1922

ENGINEERING AND MINING JOURNAL

A Weekly Journal of the Mining and Mineral Industries



The Campanile at Berkeley, California

College of Mining—University of California

By George J. Young

The Difficulties of Developing An Invention

By Alfred James

State Taxation of Mines

By McKinley W. Kriegh

THE mining industry appears indeed to be recovering from its depression. Anaconda and two other Butte companies have announced their intention to resume production soon. Conditions in most of the larger districts are promising. The situation at the mines in December is briefly reviewed on page 32.

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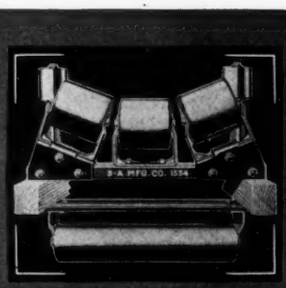

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Volume 113 New York, January 7, 1922 *Number* 1

The War of Tariffs

THE LONDON *ECONOMIST*, in its issue of Dec. 3, observes cogently:

"Just at a time when the world, if it is to recover from the waste and disorganization of war, should seek after the development of industry and the free exchange of commodities, the nations of which it is composed are doing their utmost to arrest development and to prevent exchange. The war of arms is turning into a war of tariffs. The nations are behaving as if to trade with them were the worst of injuries; they are raising walls of tariffs to keep trade away. All want to sell to export; but none, it would appear, want to buy, to import. How one can export without being paid for one's good by imports no one stops to inquire. That feverish confusion of mind which is a symptom of diseased nationalism impels them all, or nearly all, to strive after an economic self-containment, which, if it were possible, would result in economic death."

France, the editorial goes on to state, Belgium, Italy, Spain, the United States, Australia, Canada, South Africa, New Zealand, Sweden, Denmark, Peru, Bolivia, Chile, and Japan all have recently set new tariffs or are in process of doing so.

"The first thing a newly constituted state appears to think of is how best it may hinder trade with its neighbors. Esthonia, Latvia, and Lithuania, those Baltic fragments split off from what once was Russia, have all set up new tariffs in the course of the past year. Rumania's latest effort in tariff revision dates from July last, as does that of the Jugo-Slav kingdom.

"The delusion that protective tariffs 'safeguard' trade is one of the most persistent and dangerous of economic delusions, the more dangerous because superficially so plausible. Politicians everywhere, when confronted by depressed trade and unemployment, always fly to tariffs as to drugs, and refuse to realize that just as the human body pays in wasted vitality for drugs taken, so do 'protected' peoples pay in lost efficiency for the tariffs imposed upon them."

These conclusions are, of course, less applicable to the United States than to any other country; for the United States may survive with a great tariff Wall of China placed around it; but so far as we desire to be a commercial nation, exporting and importing, the principles of our economic welfare are the same as those of England and Germany, to whom the clogging of trade channels means economic death, whereas to us it means only serious disaster.

The United States Chamber of Commerce Tariff Report

THE COMMITTEE ON TARIFF PRINCIPLES of the United States Chamber of Commerce has submitted its report by a referendum to its members—to the Chambers of Commerce and other affiliated commercial organizations of the United States. This report first shows the unimportance of the tariff expedient as a source of revenue. It recalls that for the years 1918, 1919, and 1920 the customs revenue constituted only 5 per cent of the total revenue of the Government; "hence that source or revenue, which once played an important part in the cost of carrying on the Federal Government, has become an almost negligible factor, and tariff for revenue only would probably not now be advanced as a major party plea or as an economic consideration of vital importance to our people in lessening the burden of direct taxation."

The tariff, therefore, according to the report, is simply an industrial measure. The report accepts to a degree the principle of protection of American industries, and believes "that in framing tariff legislation and in the application of legislation full consideration should be given to the reasonable protection of American industries that are subject to destructive competition from abroad and that are, or promise to be, of benefit to the country as a whole or to any considerable section thereof." But it also points out that new conditions have arisen necessitating modifications in the old protective policy of the United States, and that "the United States, now a creditor nation with enlarged industrial development and expanded commerce in foreign markets, must therefore carefully adjust her tariff policies to her own changed relation to world affairs as well as to changed world conditions."

Trade Wars and Poison Gas

WE DO NOT ORDINARILY SEE *The Freeman;* by nature and tradition we are conservative, and *The Freeman* hailed the book on "Political and Commercial Geology," in which we had some private part, as radical, even though, as it observed, we did not know it. Of course, etymologically, and as we know *The Freeman* meant it, *radical* means (Latin *radix*, a root) going to the root of a matter—it is the same word as radish, which is a root—and we do not object to that; but we do not want to be suspected of complicity in the Wall Street bomb plot. So we are shy of *The Freeman*. Nevertheless, we are bound to say that an editorial handed us by a friend contains more than the glimmerings of wisdom.

This article discusses the limits of tariffs, or other artificial economic barriers, and actual economic reprisals, diplomatic contests, and finally armed conflicts which are the final stage of economic conflicts. It discusses the theory and dreams of a League of Nations, a World Parliament, or an Association of Nations, according to the hope of most of us. It discusses the hope of such an association or league, made potent, according to Senator Borah's vision, by an international judicial tribunal. *The Freeman* argues that the decisions of such a court would not work. (We know this has been true of The Hague tribunal):

"Well, why not? Simply because there is an economic barrier between France and Italy, while between Pennsylvania and New Jersey there is none. . . . Probably Senator Borah would say in all good faith that the national

solidarity of the United States is due to political agreement. Most of us do say this and sincerely believe it, but it is due to nothing of the kind. It is due to the two things: first, that the fundamental conditions of production are the same in all the states, and, second, that exchange of commodities among all the states is absolutely free. Let Pennsylvania set up a general tariff barrier against the other states, and see how long our national solidarity would last.

"Those who hold our country up as a structural model, and talk glibly about a United States of Europe or a league of nations, never seem to get through their head what it really is that united the United States of America. . . . Free the exchange of commodities, on the other hand, and your association of nations forms itself. Have we a United States of America because certain founding fathers got together in a conference, or a series of conferences, and signed their names to certain scraps of paper? Hardly. We have a United States of America because Potash and Perlmutter, in New York, can buy material from the Hamsucket Mills in Massachusetts, and sell their finished product to Smolinski and Berkowitz in Seattle, Washington, all without running the gauntlet of one single custom house. A United States of Europe, or of the world, will form itself, and form itself to stay, as soon as similar conditions of trade are established in all the states of Europe, or of the world; and there is no other way whereby one can be formed."

This gives all of us beginners at least something to think about: To agree with or disprove. We must consider economic discriminations, reprisals, and trade wars as a source of actual wars; consider the relation of tariffs, import, export, or otherwise, to national animosities, and hence to battleships, and hence taxes, since nearly all our tax burden and the cost of our government is for war, past, present, and future. Let us cogitate, then, on the ultimate relation of tariff to taxes, and figure out where we get off cheapest in the end—you and I—when the final balance sheet is struck.

The Location of Tariff Walls

IF WE ASSUME as our own the prevalent world theory of taxing imports, while seeking for an outlet for our exports—if we assume that we must protect our own industries in order that they may not be ruined by competition from cheap labor and machine production in Germany, Japan, or England—where shall we build our tariff wall? On the Atlantic and Pacific Coast; on the Great Lakes and the Rio Grande, you will say. Not so: we have a reciprocity in commerce with Cuba; a Republican (and, therefore, a tariff-believing) President sought reciprocity with Canada, which was rejected by Canada, not from economic reasons, but through Chauvinistic politics. Examples like this will recall the evident fact that it is not our territory we are seeking to protect by tariffs, but our commercial life; therefore, obviously we set the protection wall around the boundaries of our commercial sphere. Once we acknowledge this truth, we must get the economist and the trade expert to delineate those misty confines according to his beliefs.

American enterprise has a great mineral industry in South America, in Brazil, Chile and Peru—a great industry in copper and iron, feeding its own United States industrial life. Shall we draw our economic boundaries for tariff purposes outside of these? Examination of the tariff will show that actually this principle is already accepted. The emergency tariff carries a duty on pig tin, but none on tin ore. This protects the tin smelters of our East Coast, and the American-owned tin mines in Bolivia. No voice has been raised for a tariff on copper, out of the universal clamor for a tariff on every metal and mineral. Why? Because of the vast American-owned copper mines in South America. Our copper-mining commercial boundary extends past the Atlantic seaboard, into the Southern Hemisphere. We are slow to grasp the principle, but actually the same thing exists for zinc, and similar American-owned commercial interests in Mexico tend partially at least to offset the demands that have been made by purely domestic producers for a zinc tariff.

The wider our commercial boundaries grow, the more far-flung are our proposed tariff lines. For a real trading nation, like England, her tariff boundaries East and West, pass around the world and meet, and there are no boundaries.

The Doctrine of Free Exports of Minerals

THE INTERNATIONAL Chamber of Commerce, with which the United States Chamber of Commerce is closely associated, at its meeting in London June last, considered the question of the free movement of raw materials as distinguished from manufactured products. Here is a natural distinction which we would do well to bear in mind in our thought. Finally a resolution was adopted, which dodged the delicate question of import duties, but was able to secure the approval of the delegates of all the countries as regards export duties; and it accordingly recommended the abolition of export taxes by every government for a fundamental list of raw materials, including "Ores and mineral products; natural metals; precious metals; mercury; stone and earth; coal; and mineral oils." Certainly the mineral industry is sufficiently blanketed in this list. But it is the wording of the preamble which is of greatest interest to us:

"Considering that every tax on export of raw materials must necessarily increase the cost of production and thereby hinder economic development and prevent economic restoration;

"And that it is desirable to put a stop to, as far as possible, the rivalries between nations in their search for raw materials, to stamp out the cause of economic conflicts which may threaten peace, and to do away with the natural inequality arising from the fact that the riches of the world are unequally spread over its surface and to assure the rapid restoration of the world's commerce."

This lays down the principle of the *free movement outward* of raw mineral products. In effect this principle works in the interest of great manufacturing countries, and against the interest of countries possessing a great or almost monopolistic supply of natural mineral wealth. Chile must not levy, according to this, an export tax on her nitrates, nor Mexico on her petroleum, nor the Republic of Georgia on her manganese. The principle postulates that the natural raw materials of the world, such as the mineral wealth, are a common heritage or reservoir of power and wealth to which none may be barred access on the terms of ordinary trade.

Replaceable Drill Bits

THREE DIFFERENT ATTEMPTS are now being made to develop a replaceable drill bit. All are still in an experimental stage, but we believe a practical solution will be obtained in the not distant future. With an efficient replaceable drill bit, a set of standard drill-bit holders made from excellent metal, an alloy that is shock resisting, will form the equipment of each drill, and need be handled only a relatively short dis-

tance. The drill bits alone will make the journey to and from the sharpening shop on the surface. As the drill bits represent only a relatively small amount of metal, they can probably be made from a steel alloy which will be comparatively expensive but will be more efficient in drilling capacity. Thus there is the possibility of a considerable economy in drill steel and in handling steel. This is the incentive toward which the experimenters have been working.

Other attempts to make a replaceable drill bit have been made, but with the piston type of drill, used at the time, they were unsuccessful. With the hammer type of drill, the drill steel does not reciprocate, but is held more or less firmly against the bottom of the drill hole. This is a totally different condition from the piston type and it is not improbable that it is more favorable for the use of replaceable bits.

Anaconda has been experimenting with a replaceable bit invented by A. W. Hawkesworth. This bit has undergone a number of changes, and we are told has not yet been fully worked out. A general announcement or "story" appeared in the *Anaconda Standard* of Nov. 20, 1921, but insufficient details were given to make possible judgment as to its merits. Other experiments which we have known of for some time, are being conducted by the Vanadium Corporation of America and still others are being made by a Western inventor, and we have looked over his work. The subject is of great interest to the mining industries, and the hope is held out that success will reward one or more of the efforts here recorded. As soon as definite results have been obtained in this work, we will inform our readers.

The Latest Smoke Suit

SMOKE SUITS have been a common byproduct of smelting in recent years. They are all similar. The farmer owns or acquires land near a smelter, which he uses for agricultural or stock-raising purposes. Should the crop be a failure, or should the cattle die, it is most convenient to blame the smoke from the smelter. The latest suit was brought against the United Verde Extension Mining Co., and judgment was recently entered, awarding the plaintiffs a dollar apiece as damages, though the mining company will be obliged to pay about $1,600 in costs. This was the first time the matter has been brought before the courts in Arizona, though smelting districts in California, Utah, Montana, and Ontario have all been fertile fields for the "smoke farmer."

In most cases, the farmer is not sufficiently skilled in scientific agriculture to know the cause of his troubles. In some instances, the smelter fume is to blame, but more often disease is the cause, the land is unsuited to the crop raised, or the crop is not intelligently grown. State departments of agriculture can profitably devote some attention to this matter, and advise farmers wherein their troubles lie and what kinds of agricultural activity are the most promising.

In the recent case, the superior court of Yavapai County has shown wisdom in awarding only nominal damages. Even if all damage could be traced to smelter fume, in most cases the injured party depends upon those connected with the mining industry for his market, and were there no such industry he would be elsewhere. There are few smelters in rich agricultural districts.

WHAT OTHERS THINK

Orienting the Square Claim

There can hardly be a question that a square location with vertical side lines is best; but to have these lines north and south and east and west is not best, if for only the one reason that few orebodies, whether fissure veins or other deposits, run in these directions. The majority run nearer halfway between the cardinal compass points. You have shown in *Engineering and Mining Journal* of Oct. 22 what it is to locate a vein that runs crosswise of a square.

We now locate a vein with "300 ft. on each side of the center thereof."

The fairest way for the discoverer would be a square location as near parallel to the vein system as can be determined, and covering most of his find; i.e., he would have his "discovery" nearest his side line from which his vein dips. To pay $50 to hold a barren claim after five years is ridiculous.

The discoverer should have the preference. The other fellow, attracted by his find, should take what he can get.

EUGENE ANTZ.

Homestead, Ore.

Who is Apathetic?

A great number of technically trained and experienced men in this country are today out of work or have gone into another line, because they could not make a livelihood. This is true in the mining and metallurgical profession to a greater extent than any other, because the slump has been of longer duration there. But what is to be done?

Numerous attempts have been made to relieve the unemployed labor situation, but nothing has been done for the man who has trained and studied, giving up the best years of his life for a profession, and then is not permitted to continue, but is obliged to leave it to earn enough money to support his family.

Surely this is not a happy state of affairs. Does the *Journal* care? Will the majority of its readers care?

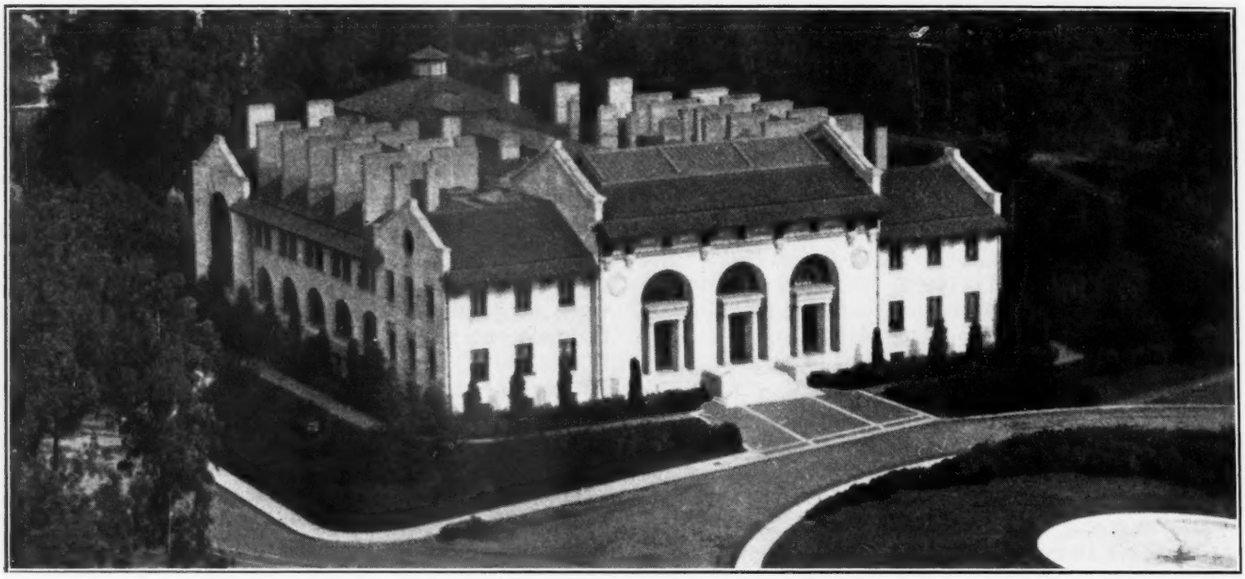
Denver, Col. J. P. VARIAN.

Standardization of Stamp-Mill Parts

I am anxious to learn how many dies or patterns would be required to cover the entire range of sizes used in gravity stamp-mill practice. In addition to the different weights of stamps, I understand that detailed dimensions vary for the same weights by different manufacturers. If this is so, if there are no standards, this fact would cause the forging plants and foundries to carry on hand a greater variety of dies and patterns, thereby increasing the cost of their products. It would seem that this one of many similar questions, would be interesting and instructive reading matter to both manufacturers and mining men.

The question of standardization of wearing parts for rock crushing and grinding machinery is one which is now being given due consideration by designing engineers. Their efforts are being applauded by purchasing agents. Every one should co-operate in this cause.

El Paso, Texas. F. N. FLYNN.



College of Mining—University of California

Historical Sketch—Relation to University—Analysis of Mining Course—Attendance Time Element—Cultural and Industrial Subjects Difficult to Include—Types of Mining Education

BY GEORGE J. YOUNG
Western Editor, *Engineering and Mining Journal*

TEN THOUSAND young people and a small army of professors and instructors can't get together in a place like the University of California without some evidence of their activity affecting both local and contiguous neighborhoods. This gets into our New Montgomery Street office chiefly as flotsam and jetsam in the daily newspapers. Recently we were informed that President Barrows deplored the gradual extinction of American humor. Forthwith the local editors proved to an edified public that that particular brand of humor was just as exuberant, potent and free from carbon on its spark plugs as it ever was.

Then along comes a column article headed by a picture of the Campanile, accompanied by a picture of the Lincoln bust which has found a home on a tall rough-hewn pedestal cemented to the south side of the tower. We are let into the secret that a considerable part of the Berkeley townspeople has entered objection to the ringing of the Campanile chimes, imported at considerable expense and thrust upon them without their special consent. The article contains the soothing suggestion that "the bells will mellow with age."

LINCOLN BUST FAILS TO PLEASE

Of the Lincoln bust, we are led to believe that an "artistic crime" was committed by both the place and manner of supporting the few pounds of bronze. In defense, we are authoritatively told that "art, to be art, does not necessarily meet with the approval of the public as a whole." President Barrows appears again, with the delicious and well-pleasing Californiaism that the student athletes of the University of California surpass the models used by the ancient Greek sculptors in physical perfection. President Barrows is alleged to have said: "Californians have been brought up here where the climate allows them to play their games all the year 'round. They are from a hardy stock of pioneers. They are called upon in competitive games such as will be played in the new stadium to give all they have in body and mind."

THE STADIUM "DRIVE"

The new stadium mentioned by President Barrows is to be built from the proceeds of a drive upon the public for $1,000,000 or more. The stadium drive was on the crest of the newspaper wave, and although some of our pessimistic business men under present conditions would look askance at this adventure, the interesting fact remains that there were enough people willing to see their names on brass plates, with an accompanying proprietary right to the seat, to subscribe to the plan of financing by the advance sale of seats to the games.

My scrapbook contains other interesting allusions to the university, but, it is unnecessary to spread them here as they will only serve to further bring out the point that the sparks that fly in the newspapers give no more idea of what is being done in a large university than the program of a vaudeville theatre does of the quality of the show itself. It is necessary, if one would really know about the modern educational processes, to become a part of them for a time at least, and even then only a superficial view can be obtained. Knowing this, I visited the college of mining of the university and endeavored to sense as far as practicable the influences upon and the work of this department.

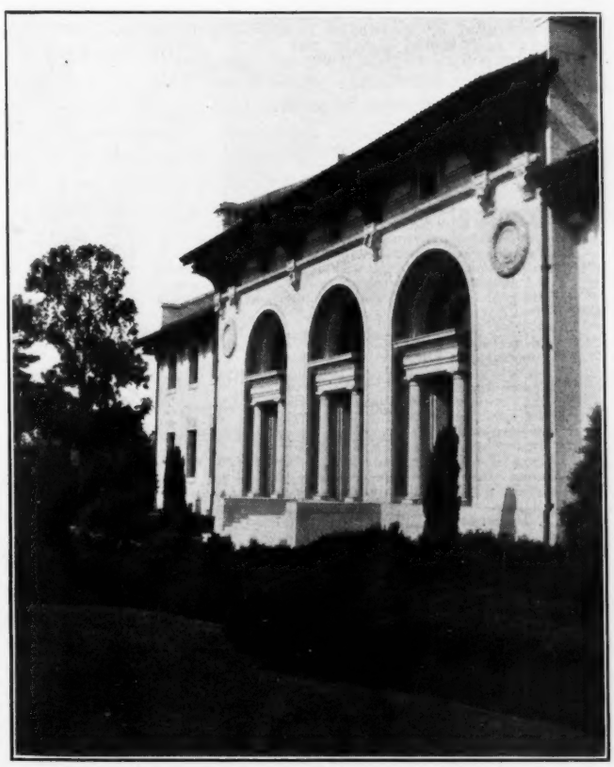
Mining is associated with many other departments which in the aggregate constitute an exceedingly complex organization. As a part, it must account to the organization as a whole. Its individual initiative is

thus made to conform to certain general principles which are more or less definitely established by the university. Its students work in various departments, some of which are definitely grouped together and others of which are merely tributary. This restriction tends to preserve a balance between the objectives of a single department and the ideals of the institution.

Advantages and Disadvantages of Contact-Education

The mingling of a single group of students, having a specific objective, with numerous groups of students having other objectives has its advantages and disadvantages. The advantages are association with many different subjects, departments and persons, all of which contributes to the contact-education of the student in greater or less degree. The disadvantage is that, in the wealth of activities, classes, social, athletic, and otherwise, there is a dispersion of interest. This is one of the weakest points of a large university like California. Only extraordinary concentration could work out the binomial theorem in a three-ring circus. What must be the state of mind of a student with only a moderate ability to concentrate in the midst of the wealth of activities, apart from the classroom and laboratory, that appear to be the rule rather than the exception?

Are there sufficient compensations for this dispersion of interest to make it worth while for the average student? I do not think that the compensations are in themselves of sufficient value to the student, but he for the most part believes them to be. Student activities are here to stay. Unless there is a definite joining of faculty and student body in an earnest effort to control them, the objectives of the universities will be lost. At California, the plan of student government offers perhaps the best solution for the control of this troublesome feature, and the steps that are being taken will no doubt be of great interest to other universities. They are not, however, germane here.



ENTRANCE TO HEARST MEMORIAL MINING BUILDING

It is almost unnecessary to state that a good proportion of the student body are earnest worth-while students and that the faculty is as representative in ability as that at any other university of similar standing. I am unable to see any special difference in the student body here as compared with that in any other university marked by a large student attendance.

The Christy Curriculum

To understand the present status of the college of mining, it is necessary to go back to Professor Christy's time. Professor Christy died in 1914. He was a dominating personality, and held strongly to his principles. Under his administration the college maintained excellent standards. It was strongest in fundamental subjects and training and developed the technical side only in so far as the available time would allow. Thus the course was divided into two years of fundamental and two years of technical subjects. A single course was provided. Such students as wished to major in geology, either did not take the mining course or followed the mining course by post-graduate work in geology. During Professor Christy's regime, the university received the Hearst Memorial Mining Building. This building is the most costly building devoted to mining education that has ever been erected. During his time, the laboratories were quite well equipped, so that in appurtenances and facilities the college is abundantly supplied.

Succeeding this regime was a two-year interval during which steps were taken to split the single course into several specialties. Dean Frank H. Probert was then placed in charge of the college, and the curriculum took definite form, incorporating separate courses in mining, metallurgy, economic geology, and petroleum engineering. In all of these courses, the first year is the same, differentiation beginning in the second year and becoming more marked in the last two years. Thus, the student must decide at the beginning of the second year what course he is going to take. All of the courses are definitely prescribed and little elective work is allowed.

The present enrollment is as follows:

	No.	Average Age.
Graduates	4	25.00
Seniors	35	22.47
Juniors	81	22.00
Sophomores	62	21.00
Freshmen	52	.....
	234	

	Per Cent
Mining option	56.52
Metallurgy option	6.96
Economic Geology option	6.96
Petroleum Engineering, option	29.56

	No.
Residents	208
Non-residents	15
Foreign	14
	237

More than half of the enrolled students elect the mining course; approximately a third the petroleum and the remainder are equally divided between metallurgy and economic geology.

Through the kindness of James Sutton, recorder of the faculties, I was given a table of the total annual enrollment of the college of mining beginning with 1897-98, up to and including 1921-22. The information is presented as a graph in Fig. 1. It is interesting in showing the erratic nature of the attendance at a well-established school in a large population center contiguous to the Western mining districts.

The steady increase in attendance up to the peak of 1903-4 was undoubtedly due to the increasing interest

in mining which followed upon the discovery of the Klondike and the Nevada silver and gold districts. The year 1907 marked the beginning of a period of mining depression which, however, did not last long. Before this time, attendance fell off, and following 1907 rapidly declined. It is a matter of conjecture as to the exact cause. In my opinion, the most important is to be

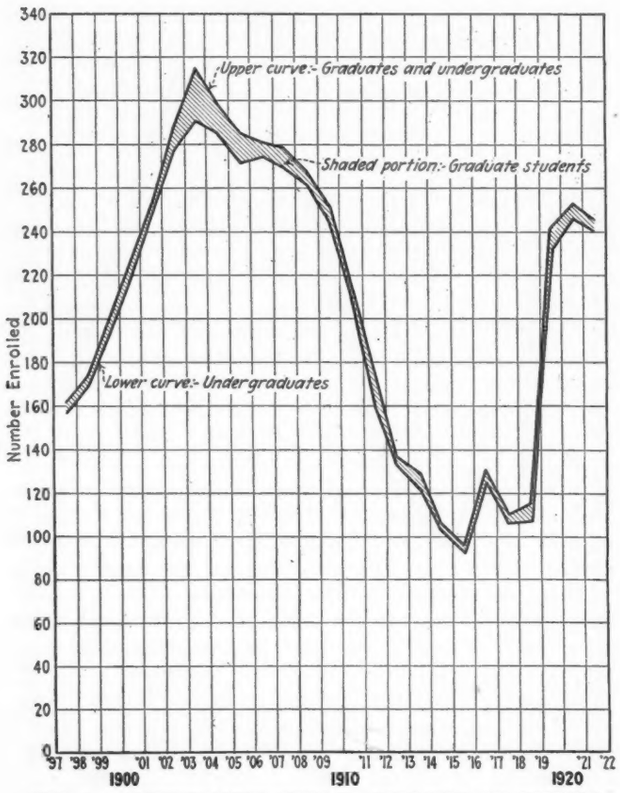


FIG. 1. ATTENDANCE CURVE—COLLEGE OF MINING

found in the more intensive development of Western mining schools which was taking place during the period and which naturally influenced the number of students who would be expected to go to the more centrally located schools.

INFLUENCE OF THE WAR MANIFEST

The war activity accounts for the minimum portion of the curve. The remarkable increase following the war period was reflected in increased attendance in other schools. This increase in attendance was due to the realization, by young men, of the value of good training as a factor in success, and to the release of many young men from war and consequent activities. Already the attendance in the mining college is diminishing and probably will drop further in sympathy with the lessened activity in mining. The graph is illuminating in showing how difficult an administration problem is placed upon a school by reason of wide variations in attendance.

Inasmuch as the mining course represents a more or less typical four-year course, an analysis of it will be worth while. Limitations on space do not permit similar analyses of the other courses.

ENTRANCE REQUIREMENTS

Entrance to all of the courses is predicated upon a four-year high school course or its equivalent. All intrants are required to take an examination in English composition, and those who fail are required to repeat the examination at the next scheduled time. The required subjects for entrance are plane geometry, elementary algebra, algebraic theory, trigonometry, physics, chemistry, and geometrical drawing; the recommended subjects, algebraic theory including quadratics, solid geometry, freehand drawing, and foreign language.

The curriculum has been analyzed on the basis of the actual hours given to a subject while in classroom or laboratory. Classroom periods are, however, only fifty minutes in length, ten minutes being allowed to cover the campus between buildings. This entails a loss of about 264 hours from the given number of lecture and classroom hours. The laboratory period is three hours, and little time is lost here. A student is supposed to put two hours of study upon each classroom period. Some do it, but instructors are skeptical as to just what return is secured from this theoretical requirement. In the analysis which follows, discrimination is made between descriptive or courses dealing with principles and courses which are determinative or have to do with quantitative measurements of some kind:

	No. of Actual Hours
Hygiene—Lectures and reading in military hygiene and sanitation	16
Mathematics—Analytical geometry and integral and differential calculus	192
Physics—General physics lectures and recitations on mechanics, properties of matter, heat, magnetism, electricity, wave motion, sound and light, part determinative	192
Chemistry—General chemistry, lectures, laboratory and quizzes	256
Determinative—Wet assaying and simple gravimetric determinations of the type used in works laboratory; fire assaying of gold and silver ores	224 → 480
Drafting—	
Conventional drafting restricted to needs of mining students	96
Descriptive geometry lectures and problems	112 → 208
Surveying—Plane surveying lectures and field practice	160
Four weeks in summer surveying class	160
Mine surveying and mine mapping, laboratory	114 → 434
Mechanical and Electrical—	
Elements of heat power engineering	48
Direct current machinery, with laboratory	80
Alternating current machinery, with laboratory	80 → 208
Engineering Design—	
Analytic mechanics (engineering mechanics)	96
Elementary strength of materials	48
Hydraulics, as applied in power plants or as of use in hydrography	48
Graphostatics	32 → 224
Metallurgy—	
Descriptive—general metallurgy lectures	32
Ore dressing lectures	32
Iron and steel	32
Determinative—Ore dressing laboratory	92 → 192
Geology and Mineralogy—	
Descriptive—	
General geology—structural and dynamic	48
Economic geology—metalliferous deposits	48
Descriptive mineralogy—occurrence and use	32 → 128
Determinative (in part or all determinative)—	
Mineralogy and crystallography	172
Introduction to petrology with determination of rocks by megascopic properties	128 → 492
Field geology—lectures and field work	192 → 620
Mining—	
Descriptive—	
General mining lectures	32
Mine rescue and first aid	30
Economics of mining	48
Mine equipment	48 → 254
Mine development and mining methods	48
Mine cost accounting	32
Law of mines	16 → 526
Descriptive and in part determinative—	
Compression of air and use of compressed air	160
Mining machinery—experiments with drilling, ventilating, pumping machines	112 → 272
Grand total	3,292

Of the total actual time, about 45 per cent is given to classroom work and 55 per cent to laboratory. This disregards gymnasium and military training, but includes approximately 8 per cent of time lost between classes. The approximate total time in the 128 weeks making up the eight terms of sixteen weeks each is 3,500 hours of lecture and laboratory instruction. On the basis of 39 hours per week there would be 4,992 hours in the 128 weeks, or about seventy (including

the 8 per cent lost time between classes) per cent of the total time is utilized.

The interims between terms, after omitting 4 weeks given to summer surveying and 4 weeks for mining observations, leave 52 weeks, or 2,028 day-hours, at the disposal of the student. Adding to this the surplus day-hours during term time (1,492 hours, including, however, a certain number of hours for thesis or for the preparation of a report on summer mining observations) gives a total of 3,520 day-hours at the command of the student during the four years in which he is at college. The demand time for the whole period slightly exceeds 50 per cent of the total time of the student, not counting more than 39 hours per week. It will thus be seen that the student has at his option slightly less than 50 per cent of the day time in a 39-hour week throughout the four-year period. He has in addition Sundays, Saturday half-days and evenings in which to play, work at his studies, or earn his way.

In Fig. 2, the four divisions into which the total time in the four-year course is divisable are represented. Three of the time divisions are approximately equal, and the fourth is slightly smaller. In this visualization of the time element it seems to me that there is an important point for educators to consider. Would it not be valuable for the faculty of a given group to induct the students into the habit of efficiently using the time in excess of that required for formal instruction? Let the student look upon time as representing a money value of $1 per hour. This is a small value to put upon it when one considers that the four years in a college course are the culminating preparation for life's work. Perhaps, also, in this more economic use of a student's time will be found the solution of excessive "student activities" of the unproductive kind.

The course as a whole may be criticized in that it is deficient in any attempt to give added power to the student in written and oral expression, in language or in fundamental economics. Apparently there is time for a capable student to get instruction in such subjects, and it may also be inferred that there is sufficient practice in the various subjects to develop written and oral expression. I was also unable to determine how much of the course entails passive receptivity and study and how much really develops personal power in the student. My impression was that more could be done in developing personal power by a greater use of the quiz method and a liberal number of problems consistently distributed throughout the term time.

Elements of Current Study Course

Compared with the older course, there is less of fundamental subjects and more attention to mechanical equipment, and greater familiarity with compressed air, steam, and electricity is required. The geological and metallurgical are perhaps less strongly developed and the engineering element is about where it was. The course deals largely with the objective side of mining—practice, processes, rocks, ores and geological structure. A conscientious student could at the end qualify as an assistant to a draftsman, assayer, works chemist, surveyor, geologist, or, in minor capacity, to a superintendent. In other works, it is one step in advance of the vocational school in that it supplies service men and minor executives who may by diligent self-study, close observation, and experience under varying conditions qualify for greater responsibility and some eventually land in the higher consulting and operating positions.

Whether an attempt is made specifically to outline the study to be superimposed upon the work at college is not apparent in the outline of courses. Just how much the university does in supplying inspiration and vision to its product, so that a fair proportion may in time develop into leaders of the kind required for the continuation of the industry, is also not apparent.

Is a course devoted so largely to the objective side of mining one that will stimulate vision and capacity? Does it leave the ambitious graduate with sufficient background to strike out in the direction of high attainment? It seems to me that the objective course leaves these questions largely to the student, and he must also plan his own study after he leaves college.

New System Emphasizes Services to Rank and File

We are prone to associate the idea of leadership with the university system. This ideal of leadership has been a part of it. It is so to a less extent now. There was a time when the proportion of students showing marked personal power was conspicuous. There are probably as many now or even more, but they are submerged by great numbers of students of ordinary ability. Perhaps the students of marked ability are not going into mining at all. Thus the problem of the university has changed, and it is no longer one of developing the leaders and letting the rank and file follow along, but now it has to take care of the rank and file and let the leaders take care of themselves. It is wisdom to plan a course to meet the needs of the great-

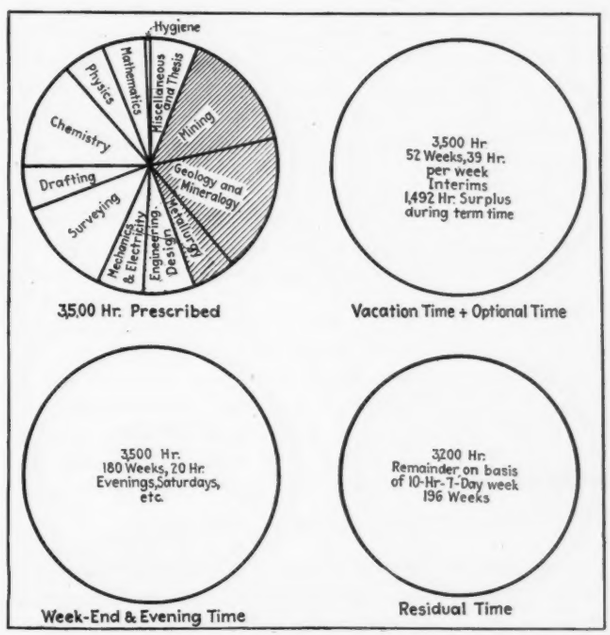


FIG. 2. APPROXIMATE GRAPHIC ANALYSIS OF TIME IN FOUR YEAR COURSE

est number and one that will range with the capacity of the average.

Looking at the outline of the course, it would appear that the metallurgical element could be extended more thoroughly to cover the metallurgy of the major metals. It would also appear that the time allotted for the study of metalliferous deposits is hardly sufficient to

more than introduce the subject. In engineering design, the basic subjects are given, but they are not threaded together in such a way as to give the student a clear conception of their use. To some extent they are made use of in thesis work, but I am informed by Dean Probert that the thesis is undertaken only by very capable students, and other students are required to write an extended report upon their summer mining observations.

The "human element" is covered to some extent, no doubt, in the courses, but no conspicuous attempt appears to be made to go into this subject thoroughly. Labor enters so largely into the mining industry that it would appear to me that the subject should be studied in many of its phases and presented to the student as thoroughly as possible. It is as fundamental as mathematics and should therefore find as definite a place.

Advantages of Cultural Development

Viewed as an engineering course, many subjects are lacking. Sociology, economics, psychology, history, all in relation to industry, find no place. Civil contact of industry, exemplified by regulatory legislation and business law, is absent. To attempt such subjects in a four-year course would be considered by some to be unwise. Nevertheless, they are essential to the engineer and must be self-acquired at some time in his career.

Much has been written and discussed about the cultural side of the engineer and the need to develop this. If familiarity with literature, foreign languages, political and economic history, together with ability to write and talk on various subjects is meant by this term culture, then it is obvious that the objective mining course described before, entirely overlooks this phase. Again, it is a practical question of the utilization of the students' time. If any time be given to it, something must be sacrificed. Some will see justification in not making this sacrifice in the fact that there is acquired more or less culture in living the life about us. The student's viewpoint must also be taken into consideration. Obviously, if the student is not interested in cultural subjects—and many of them are not—it would not be practicable to incorporate them in the course.

Engineers may plan a course which in their judgment is best for the young man entering college. Unconsciously or otherwise, they try to provide for their individual shortcomings and overlook considerations of practicability with respect to the younger man's point of view. Whatever is served up to the average, not the exceptionable, young man must be palatable.

Considering Personal Preferences

The objective course has been developed, partly by considering specific demands from the industry and partly by what the average young man wants or thinks he wants. If it starts him off in the industry, he is apparently willing to forego a more comprehensive attempt to prepare him for higher positions.

Thus it would seem that there is room for several different kinds of mining courses, one of which I will designate the objective course, the other the engineering course. The greater number will be served by the former and a much smaller by the latter. Whether by design or not, the College of Mining has elected to serve the former rather than the latter.

The College of Mining of the University of California has a background of achievement that compares favorably with that of the best of our mining schools. This has been the result of an objective course based upon the secure foundation of fundamental studies. As one of a group of schools committed to the four-year mining course, it has in recent years increased the practical value of its work instead of its horizon. It will probably be undisputed that a large proportion of its students have no immediate need for cultural and industrial science courses. On the other hand, a certain smaller proportion would have their future progress benefited by them. No one program can satisfy the capabilities of all, although it may serve the needs of the greatest number and be keyed to their pace. To provide for the very capable, the prescribed course should be made flexible. For the average student, on the other hand, a strong effort should be made to secure a proper utilization of the time, with the objective of securing thoroughness in whatever line of endeavor is attempted.

British Columbia's 1921 Metal Production Estimated

An estimate, based on such official returns as were available slightly more than a month before the close of the year 1921, places the value of the metal production of British Columbia for that year at $24,553,909. The 1920 output had a monetary value of $35,543,084, so that it may be expected that there will be a decrease for 1921 of about $10,989,175 or 30.9 per cent. A detailed estimate of the 1921 output and a comparison with the official figures for 1920 follow:

APPROXIMATE ESTIMATE OF THE 1921 METAL OUTPUT OF BRITISH COLUMBIA

WITH COMPARATIVE FIGURES FOR 1920

	Production, 1920		Estimate, 1921		
	Amount	Value	Amount	Price	Value
Gold, placer	.....	$221,600	.....	$20.67	$220,000
Gold, lode, oz.	120,048	2,481,392	106,000	.....	2,191,020
Total gold		$2,702,992			$2,411,020
				Cents	
Silver, oz.	3,377,849	3,235,980	2,550,000	60.23	1,535,865
Copper, lb.	44,887,676	7,832,899	30,000,000	12.40	3,720,000
Lead, lb.	39,331,218	2,816,115	43,000,000	4.08	1,754,400
Zinc, lb.	47,208,268	3,077,979	45,000,000	3.83	1,723,500
Total		$19,665,965			$11,144,805

Laboratory Volatilization Experiments

In a study of the chemistry of the volatilization process, being conducted at the Intermountain Station of the Bureau of Mines at Salt Lake City, an experimental set-up has been designed and constructed for the measurement of equilibrium. Enough runs have been made to show the method of experimentation to be practical and capable of results. A series of experiments were carried on, dealing with chloride volatilization of lead, zinc and copper as chlorides, using chemically pure lead, zinc and copper oxides and sodium chloride as a chloridizing agent, the object being to ascertain whether sodium chloride reacts with the oxides named above, giving off the metals as chlorides. Laboratory voltilization experiments have been made at the Intermountain Station on the Yellow Pine ores, the purpose being to determine the effect of various thicknesses of orebody, rabbling, chloridizing, and the effect of varying the amounts of air over the ore in the furnace.

The Difficulties of Developing an Invention: The Story of the Cyanide Process

The Practical Demonstration of an Improvement Is Not Necessarily Followed by Commercial Adoption—World-Wide Use of Cyanidation Due to Indefatigable Work of Pioneers, Who Never Received Adequate Financial Reward

BY ALFRED JAMES
Annual Christmas Letter to the Profession

PROGRESS in the development of the metallurgy of gold and silver was not notable in 1921, and I have therefore decided to devote my annual letter to a consideration of what it really means to establish an improvement in practice. A pioneer in volatilization work calls attention to the difficulty encountered by almost every keen enthusiastic inventor: that of finding sufficient financial support. A patent for however brilliant or useful an invention is likely to be regarded by capitalists as a gamble rather than an investment. But the inventor is none the worse for having to rely mainly on his own resources, even for the development of a world-famous invention. It is indomitable keenness, proof against all discouragement, that develops grit and results of practical value.

INVENTIVE GENIUS SELDOM ADEQUATELY REWARDED

History shows that the royalties derived from even the greatest epoch-making invention are usually small recompense for the ingenuity, skill, patience, investigation, determination, cheery optimism, work and capital expended in bringing the invention to a successful issue, and in, what is still more, forcing its adoption on a public which generally requires some years of education as to the advantages to be gained. Hence it generally happens that the fourteen years' protection granted in England on an epoch-making invention covers little more than the period of incubation, nursing, and developing to adolescent capacity.

Possibly the epoch-making inventions of the day are propulsion of vessels by steam turbines, radio-telegraphy, airplanes, and wave transmission of power. To discuss the first: After fourteen years of incessant effort and skillful striving, Parsons found himself at the end of his patent life with little more than his expenses. The history of Marconi is widely known. It was not until after many years of ceaseless ingenuity and untiring brilliant invention that the shareholders financing Marconi received a single penny on their money invested. The Wright brothers were never reported as entertaining royalty or as marrying European princesses, and I understand Constantinescu has not yet received serious reward for the civil use of his inventions.

But apart from the smallness of the remuneration, another feature stands out strongly: that but for the invincible enthusiasm and dogged determination of the inventor every improvement would be the failure in practice it is at first almost universally pronounced to be by those learned in the art. It is, therefore, of the utmost value to the industry that the connection of the inventor with the working of his invention should be obtained, maintained, and encouraged.

Professor Elihu Thompson says: "Publish an invention freely, and it will almost surely die from lack of interest in its development. It will not be developed, and the world will not be benefited."

It is essential that sufficient inducement be offered to obtain that fostering care which provides the main difference in results between many a successful process and previous attempts to accomplish the same purpose by similar or even well-nigh identical means. It is for this reason that so-called "anticipations" are pernicious. Disinterred from the dust and cobwebs of antiquity, unexplored except for the purpose of an action at law, they by-pass the main wealth and value of a patent—the toil, expense, skill, perseverance, and grit expended in its development. The anticipations were absolutely valueless from the lack of these adjuncts—ideas are cheap; it is work which develops fruitfulness.

I hope to live long enough to see infringers thus relying on a prehistoric "anticipation," not merely treated with derision, but mulcted in a penalty for their failure successfully to employ, prior to the introduction of the contested invention which taught them the way, the anticipation they later bring forward as their defence in an action for infringement. Whence derived the infringers their valuable knowledge; from the patent or from the anticipations? The inventor today is unjustly treated: the world over, the patent law is unfair to him on this point. A better plan might be to deal with an invention as with a copyrighted book: reward the inventor for life with a small royalty from users; but the invention must first establish its novelty. Once established the state should uphold it.

Industry everywhere must be made to realize the cost in time, money, skill, enterprise, courage, and keenness that is required to develop successfully an epoch-making process, and I therefore intend this year to deal specially with what should be now a matter of history—viz., the forcing on the industry of the cyanide process. Many inaccurate statements appear from time to time in the writings of learned men who have obtained at second hand the history which is not within the scope of their own experience. I therefore published many years ago in the special twenty-first anniversary number of the *South African Mining Journal* an authoritative account from, and substantiated by, the official records. I am convinced that greater publicity should be given to that account.

FAILURE OF ANOTHER PROCESS LED TO EXPERIMENTS WITH CYANIDE

One has to go back to 1886 to appreciate the effort of the parties mainly responsible—Messrs. Wright, Verel, and Gow, of the Cassel Gold Extracting Co. In that year this company found itself faced with the sudden disappearance of inventor and secretary and the collapse of a process which could not be made to work. The board, undeterred by the flight of the inventor, determined to make the process work. It was found that instead of being a cheap method of gold extraction, it was in reality an expensive way of producing bleaching powder

by the electrolysis of salt solution, to which lime was from time to time added. At this time J. S. MacArthur wrote an article to the technical press showing how the process should be worked. The board therefore secured Mr. MacArthur's services, which resulted, however, in no improvement in results. MacArthur brought forward a little thing of his own, the extraction of gold from ore by solutions of ferric chloride. But this method proved to be not feasible in practice.

Still undeterred and anxious to press forward the process, the board next investigated MacArthur's suggested process of the use of solutions of cyanide of potassium. And now, with success apparently at hand, fresh difficulties and worries arose, to be overcome only by a display of such enthusiasm and bravery as but few men have shown under similar conditions, either before or since. The board had already dispatched an unsuccessful expedition, consisting of Messrs. Feldtmann and MacArthur, to the property of the St. John del Rey Co. to fulfil a contract entered into for the old process, and, undismayed by the lack of results, resolved on sending out a number of expeditions to introduce the cyanide process and to educate the mining community to an appreciation of its advantages. The first expedition (the Messrs. McIntyre) was sent to Queensland; the next to New Zealand (Mr. McConnell). From these two expeditions little that was tangible resulted. The Messrs. McIntyre demonstrated on concentrates and pyritic ores in iron pans, and Mr. McConnell erected a successful ore-treatment installation at Karangahake; but all this work attracted no users except for Dr. Scheidel's small concentrate plant at the Sylvia (1890).

Early Work Metallurgically Successful But Not Generally Adopted at First

The lack of success of these two expeditions, from the point of view of forcing a process on an industry or gaining adherents, in no way damped the ardor of the board. Before long a fresh expedition was planned to Africa (in the latter part of 1888), and a year later MacArthur was also sent off on an expedition to America. This latter expedition of MacArthur's was not a success; indeed, it was not until some years later, after the process had accomplished great things in Africa and New Zealand, and Dr. Scheidel had proceeded from the latter territory to California, that the application of the process in Mexico and the success of cyaniding at Mercur compelled the attention of the mining interests of the United States.

It will thus be seen that, of four expeditions, one only, the African, was successful in gaining adherents, and even then a further expenditure of time, money, and energy was necessary to force the process into general use.

Let us look into the history of the African introduction. A study will serve to show the enthusiasm, skill, courage, capital, and business energy necessary to convert even a successful demonstration into a general adoption. The pioneer in Africa[1] arrived toward the end of 1888, and in accordance with his instructions at once proceeded to Lydenburg, Barberton, and the Horo mines, in Swaziland, it being the intention of the board to demonstrate the process in either the first- or last-named district. Certain investigations were made by the pioneer which decided his future course of action; but his visit to Barberton and his investigations at the United Pioneer (Moodies) caused J. H. Cordner-James to form a local syndicate, at the outset consisting of J. M. Buckland, W. W. Webster, and himself, to acquire the African rights of the process. This step was the first real encouragement received by the keen and determined Scotsmen who had been so long pushing the process, and it undoubtedly was the cause of the subsequent demonstration being on so large and effective a scale.

The First Trials of the Cyanide Process on the Rand

From Barberton the pioneer came to the Rand, and after an examination underground, possible mainly owing to the extreme courtesy and kindness of the late Hermann Eckstein, of well-nigh every mine of note (over eighty) in the district, from the Nigel to Blaauwbank and Malmani, he settled down to conduct a series of experiments in an assay laboratory at the Langlaagte Estate, placed at his disposal, entirely without charges for laboratory, stores, or labor, by the liberality and shrewd foresight of Mr. (now Sir) J. B. Robinson. The investigations completed, the African pioneer returned to Scotland to consult with his board as to the offer made by the local syndicate to purchase the South African patents. This was subject to the success of a public demonstration of the process to be held at Johannesburg, and the pioneer designed the necessary installation and brought it to Johannesburg early in 1890.

Meanwhile, one of those worries which daunt the most enthusiastic inventor cropped up in the matter of patent rights. On his original arrival in Capetown the pioneer had found that Dr. Wernher von Siemens (represented by E. Lippert) had a patent for a cyanide process, with electrical precipitation, dated only a month after the MacArthur-Forrest patent. Young and inexperienced, the pioneer did not deem it necessary to worry his board with such disquieting information; he decided on the spot to raise an action for the revocation of the Siemens patent. That such an action had never before been brought in the colony, and that his attorneys proved also to be the Siemens attorneys in no way disquieted him. His attorneys had to choose between the two clients and to proceed with the action. This step was most fateful to the future of the South African patents, for on his arrival at Pretoria he found that some local difference of opinion as to the difference between the Taal and High Dutch had caused the postponement of the acceptance of the MacArthur-Forest application until a month after that of Siemens, who thus had prior rights in the Transvaal. Nothing daunted, a similar action—but with apparently less ground—was raised at Pretoria to that started at Capetown, and a report made by letter to his board as to the condition of affairs and his consequent action.

The result is distinctly interesting. The Cape courts decided in favor of MacArthur-Forrest, as the true and first inventors; and the Transvaal court, although in this case Siemens had the prior date, decided to follow the decision of the old colony. I am informed that these were the first two patent actions in South Africa. On so little hung the fate of the introduction of the cyanide process into the Transvaal!

The demonstration plant, referred to previously, was erected by arrangement with the Salisbury company, at its battery. The enthusiastic encouragement given to the process by the manager, R. A. Michell, is gratefully

[1] Mr. James modestly refrains from personal references to himself in this article, but he was "the pioneer."—EDITOR.

remembered by those who were naturally very appreciative of the slightest expression of approval in those early days. It is only fair to refer also to the attitude of the press and to the value of the publicity and encouragement freely and cheerfully extended to the pioneer of the process. Dormer, of the *Star;* Rathbone, of the *Mining Journal;* Piet Davis, of Maritzburg, were towers of strength. They awoke the interest of the community, and, indeed, prepared the way for the subsequent adoption of the process.

I have had naturally much experience with the daily, the financial, and the technical press in four of the five continents. Great publicity has been given at great length to my technical writings and to my work (whether I wished it or not), but never in all my professional career have I known of a single instance of payment for press services so generously and spontaneously rendered.

By April, 1890, the demonstration plant at the Salisbury was ready for action, and early in May Mr. MacArthur, whose presence it was considered would be of especial value to the syndicate at this juncture, arrived at Johannesburg, where the demonstration took place, the pioneer having first run one hundred tons through the plant so as to have the staff acquainted with their duties and the plant running smoothly.

The success of the demonstration is well known. Later, in 1895, Hennen Jennings reminded me that the results then being obtained at the Crown Reef were precisely those obtained by him and J. R. Williams (afterward famous for his successful process for treating slimes by decantation) in 1890 at the demonstration; but the fact remains that, excepting the manager (Mr. Michell) of the property on which the plant stood, no one adopted the process!

Inventors Must Overcome Prejudice in Favor of Old Processes

This should be well considered and taken to heart by all persons fathering a new process, as it is just one of the difficulties by which an invention is faced. Practically every epoch-making invention is pronounced a failure at first, wherever exploited, and it is only the invaluable enthusiasm of the inventor and his financial associates which enables them to survive this adversity and ultimately to force the process on the industry.

The Gold Recovery Syndicate, which had contracted to purchase the patent rights, thus found itself, in the latter half of 1890, with no backing and no adherent other than Mr. Michell, but for whom the syndicate would have had the demonstration plant left on its hands. Mr. MacArthur had returned to Scotland, taking with him his check in payment of the plant, and it was left to the syndicate, with which was associated the pioneer, to take other and still more vigorous measures to force the adoption of the process. That these measures were taken was due mainly to the keenness and decision of W. W. Webster, who determined to spend his last penny, refusing to be discouraged, rather than fall short of complete success.

It was at this juncture that a Scotsman connected with one of the local banks came to their aid. Funds were thus obtained by which advantage could be taken of the liberal terms on which Hennen Jennings offered a block of valuable Robinson tailing, thereby enabling himself to obtain greater knowledge of the practical working of the process.

Up to this time the process had been described as for refractory ores and concentrates only. The demonstration was limited to the treatment of material of this nature. An installation was now designed by the pioneer for the treatment of tailing by percolation. This modification in the method of carrying out the process involved a change from the agitation of small charges in cylinders fitted with paddle agitators to the gravity percolation in large tanks of considerable quantities of material, and was so novel as to induce Mr. MacArthur's greatest friend on the Rand to state that the process was a new one and ought to be named jointly after MacArthur and the pioneer; but this suggestion never appealed to the latter.

The invention had been completely and thoroughly worked out by MacArthur and his associates; probably no invention has been placed before the public more completely and thoroughly developed. The fact that the carrying out of the invention, as originally put into practice, in Australia, New Zealand, America, and South Africa, had failed to induce a single adherent (other than Dr. Scheidel, with his small concentrate plant at the Sylvia) to adopt the process, made it obvious that our *modus operandi* was wrong. The adoption of gravity percolation made the process commercially successful and of world-wide acceptance, spreading from South Africa to New Zealand and India, with later adoption in the United States and in Western Australia, where inappropriate methods of introduction had caused a setback.

The new plant at Johannesburg was built by Messrs. Tarry in December, 1890, under my supervision, being laid down according to the plan of operations carried out by Messrs. Webster (manager), Gaze, and Darling. The plant did not meet with the approval of the authorities in Glasgow, who had sent out a plan of a small (8 x 6 ft.!) square Tharsis tank as one to be followed, and it gave me no little satisfaction to be able to reply, to a letter prognosticating failure, with an account of the great success of the plant. Within two months of the starting of operations, the plant was showing a profit of over £2,000 a month on an original outlay of about £3,000, the African Gold Recovery Co. was formed, and Mr. MacArthur was sent out by the new company to arrange for the local conduct of its operations.

Not even yet, however, was the process forced on the industry. The new company decided to continue the profitable operation of the treatment of tailing on its own account. New contracts were accordingly entered into with other companies, such as the Crown Reef and the Meyer and Charlton; and then at last the companies decided to adopt the process, and the fight was won.

Early Hardships of the Developers of the Process

After five years' hard work, involving the training of many metallurgists, the erection of a cyanide manufacturing works to prevent the supply of cyanide to the mines being restricted, the dispatch of six expeditions, the fighting of two lawsuits, and the carrying out of much chemical research, such as the use and effects of cyanide, alkalies, oxidizers, lead salts, and alkaline sulphides, the manufacture of cyanide by various processes, and the expenditure of over £100,000, an epoch-making process of the greatest success had been forced on an industry.

It is only a fair conclusion to state that but for the

expenditure of so much dourness and determination, of so much patience and encouragement, of so much business common-sense and foresight, and last, but not least, of so much capital, the discovery of MacArthur and the Forrests, and of their financial associate, Morton, would not have been made available to the industry for many a year, but would have laid fallow as a non-pursued chimera with the unfollowed-up ideas of Faraday, Bagration, or the more practical processes of Rae and Simpson.

The Question of Reward to the Pioneers

And what of the reward offered by the industry as remuneration for so much enterprise, effort, and success? This question can scarcely be left to the industry. As to whether, after the result of the action taken by them—a result which, in view of the decision of the English Appeal Court, would have conceivably been different had the Transvaal been at that time a British colony, with right of appeal to the Privy Council—the mine owners might have felt called on to make some remuneration to the patent owners who had so fostered the introduction of the process, one can understand that after the expense, worry, bitterness, and exhaustion of a prolonged fight a feeling of relief at the result would predominate over all other sentiments. But surely it behooves the industry in its own interest to see that the result of the challenging of the MacArthur-Forrest patent is not to deter other inventors from putting forward their methods in the Transvaal. Such a result appears to have already involved the Witwatersrand in an annual loss far greater than the royalty it would have been necessary to pay had it not challenged the patent.

Why Not a Pension Fund?

There is one other matter which arises from the consideration of the effect of the severing of the interest of the pioneer group in a new process. Those who have grown gray in the working of the new process may feel that they have not the prospect of a retiring pension for their old age. Such a thing might have been relied on had a pioneer company still continued its ownership to the usual period of patent expiry. Nine years ago I suggested that the greatest gold field in the world could be large hearted and could perhaps pardon a suggestion that a small contribution from the mines of a fraction of what they had saved in patent royalties would suffice to establish a fund, called, say, the Cyanide Pioneers' Pension Fund, from which all cyanide pioneers in charge of plants from the earliest days of the process (first plants at each mine) who continued in the industry, not necessarily as cyaniders (they might have since become managing directors, consulting metallurgists, reduction officers, samplers, or assayers) might, on their retiring after twenty years' service, become entitled to draw a pension of, let it be assumed, £300 a year for life. I regret that my proposition met so little response on the part of the South African mine controllers. I trust to live long enough to see it adopted.

It has never been realized that the industry, the world over, has had the free use of an apparatus which has stood the test of time, and is still used practically unaltered, but which was designed for and first used on the Robinson tailing plant. This box could have been patented. Originally, gold was precipitated from its cyanide solution by zinc shavings placed in chloride of calcium tubes; subsequently earthenware pots were used for a similar purpose. For the Salisbury demonstration plant teak boxes of four compartments were used, each compartment having a cast-iron box, with perforated bottom, which could easily be withdrawn to facilitate the cleaning-up operations for demonstration purposes. For the Robinson plant, however, a box of novel type was specially invented. It had a series of compartments with a space for the inflowing solution, which was conducted by a baffle to the bottom of a large compartment in which was placed an easily removable tray on which the zinc shavings rested, and up through which the gold solution percolated, with a downward movement through baffle channels only.

At the bottom of each compartment was a space for gold precipitate, and connected to the bottom of each compartment was a pipe, or channel, for drainage and cleaning-up purposes. For a generation that box, except that it is now frequently made of steel, has been wellnigh universally adopted for the recovery of the precious metal. A royalty of £20 a box—such as is freely given for a cone or tube mill feeder—would not have been at all excessive. Probably ten thousand of such boxes have been used on the Witwatersrand alone; a small gratuity or recognition per box placed to the credit of a Cyanide Pioneers' Fund should have sufficed to make comfortable. for the period of their lives, those pioneers (first men on first plants of mines only) who may now find themselves seeking rest after the completion of their thirty years' toil.

Collecting Diamond-Drill Sludge

In a paper prepared for the February, 1922, meeting of the A. I. M. E., R. D. Longyear describes methods of taking care of diamond-drill cores and collecting the sludge. Allowing the sludge to run into a tub and overflow should not be done unless there is no tendency for concentration. A sludge box with baffles is an improvement but the best method is to run the return water into three or more barrels through a pipe or launder. When one barrel is filled, the pipe is swung to the next barrel, and so on. After the material in the first barrel has settled sufficiently so that the clear water can be siphoned off, the barrel is again filled. The process is continued until the end of the interval to be sampled. All of the material is then poured into one barrel and allowed to settle further. After all of the clear water has been drained off, the residue is removed, slowly dried over a fire, quartered, and sacked. The number of barrels used depends on the time necessary for the material in suspension to settle. When this method is used, the hole must be in such condition that all of the cuttings are washed to the surface. On one of the large copper deposits in Arizona, this method gave remarkably accurate results even though less than 50 per cent of the core was recovered. Later test pits and mining operations checked the drill sampling within 0.005 per cent in carbonate ore and 0.05 per cent in sulphide ore. A bit recovering a 1⅛-in. core was used. The choice of sampling methods must depend on the engineer's judgment of the character of the material to be sampled. In case of doubt, it is better to err on the side of accuracy than to risk getting a worthless sample.

State Taxation of Mines

Varying Methods Employed—General Property Tax Makes Valuation Necessary—Ability To Pay Should Be Considered—Inequitable Distribution of Burden Hurts Mining Industry—State Residents Profit Most from Mineral Enterprises

By McK. W. Kriegh
Written for *Engineering and Mining Journal*

MINES AND MINERAL PROPERTIES in different states are subject to dissimilar systems of taxation, varying rates, and divers methods of valuation. The general property tax or ad valorem system prevails; but, in some states, mines, including idle and unprofitable properties, are subject to ad valorem tax on the value of their mineral content, and, in addition, are required to pay a tax on their output. In other states a differentiation is made between producing and non-producing properties, the producing being taxed both on output and surface value of the land and improvements thereon, and the non-producing only on surface value and improvements; and in still others, a production or severence tax is levied in lieu of the general property and other taxes.

Some of the states impose excise, income, and capital stock taxes, which add to the tax burden upon the mining industry. When a new and increased tax is imposed, it is because additional revenue is needed, and the local taxing authorities make a survey of the taxable resources of their respective jurisdictions, and usually pounce upon the one which will yield, at least temporarily, the largest amount of revenue. In many of the mining states the burden upon mines is wholly out of proportion to that imposed upon other taxable property, and is being increased without regard to the injurious results which may accrue both to state and nation.

General Property Tax Necessitates Valuation

The general property tax is the common designation applied to all direct taxes upon property, real and personal which are apportioned and levied by substantially the same methods. Under existing laws, general property taxes are levied without reference to benefits conferred upon or enjoyed by the taxpaying property owner. Where the tax burden is heavy, as in practically every state, there is a constant struggle between different groups to have the burden shifted, and this is accomplished, when one group gains control of the legislative or administrative machinery, by the adoption of different methods of determining what constitutes taxable property and different bases of valuation for different classes of property. In all mining states where the general property tax serves as the principal source of revenue, owners of mining properties are confronted with the vexing problems of valuation and unequal adjustment of taxes.

The measures of valuation in the different states are many and varied, and there is much conflict of opinion as to what represents value or what value means. The Arizona law defines "full cash value" as "the price at which the property would sell if voluntarily offered for sale by the owner thereof and not the price which might be realized if such property was sold at a forced sale." The Illinois law provides that "in valuing any real property on which there is a coal or other mine, or stone or other quarry, the same should be valued at such a price as such property, including the mine or quarry, would sell at a fair voluntary sale for cash." The Kansas statute defines taxable value as "the true value in money . . . determined by the assessor from actual view and inspection of the property." It must be assumed, of course, that a Kansas assessor, after giving the mining property the "once over," can instinctively determine its true value in money.

Missouri Law Defines "Cash Value"

The Missouri law requires mining properties to be assessed at their "true value in money," and the Missouri tax commission in its biennial report for 1917-1918 declared: "There is nothing uncertain about the meaning of 'actual cash value,' 'its value,' 'its true value in money,' or the method of determining it. It is not necessarily what was paid for the property; nor what it would now cost to reproduce; nor what it would sell for at a forced or auction sale; or in aggregate with the other properties in the community; it is not necessarily to be determined from the income it produces; nor the pleasure it gives the owner; nor the price he may demand for it. It is the usual and customary selling price at a private sale, under normal conditions, when a ready, willing, and able seller deals with a ready, willing, and able buyer in the community where the property is located."

Other state laws define value as the rate at which the property would "be taken over for a just debt due from a solvent debtor" or "sell at a fair and *bona fide* sale on private contract" or "sell for at a fair, free, and well advertised sale," or "sell when sold in such manner as property is usually sold," or "sell at court sales for partition."

Methods of Valuing Mineral Properties Varied

As mines and mining properties are not usually bought and sold in the same manner and under the same conditions as other property such criteria of value are rarely available. Therefore, the valuation of a mineral deposit or different classes of deposits is in each state a special problem, and the taxing power of one state will adopt annual gross and net proceeds of producing mines as the measure of their value; another will capitalize the value of net earnings averaged for a past period of years at fixed percentages for different groups or classes of mining property, or another will attempt to determine the present value of its mines by capitalizing estimated future profits.

For the purpose of this article, "value" may be defined generally as intrinsic and extrinsic worth, determined in terms of money. Is it possible to determine the value of a mineral deposit in terms of money? If mines were ordinarily the subject of barter and sale, the answer might be unqualifiedly in the affirmative; but the elements which enter into the determination of value rep-

resented by a body of ore or mineral in the ground are not easily comparable to those which fix the surface value of real estate, the going value of a business, the economic value of a public utility, or the commercial value of an article or commodity used in trade, which constantly are changing hands for a monetary consideration.

To have a commercial value, a mineral deposit must possess certain characteristics as to quantity, quality, availability, and demand which make it capable of profitable utilization. These elements cannot be easily determined, even by those who possess expert knowledge, and therefore there is introduced the element of extraordinary risk, which must be taken into account in any undertaking involving the development of such a property. An examination of the conditions prevailing in different states leads to the conclusion that a method of valuing mines in Alabama, Illinois, Michigan, or Minnesota might not be feasible for the valuation of mines in Arizona, Colorado, Idaho, New Mexico, Utah, Wyoming, or other Western states.

Ability of Mines To Pay Must Be Considered

In assessing mines, consideration should be given to their ability to pay. Mines which may have been able to pay a very heavy tax in 1917, 1918, or 1919 may now be unable to pay any tax whatever, or even to bear the cost of retaining a sufficient personnel to guard their property until a future demand for their product will enable them to resume operations.

Under a system which uses the average production basis as the measure of valuation for determining tax liability, many non-operating properties are severely penalized, their taxes amounting literally to confiscation of their property on account of the fact that in taking the average production for a past period, particularly for the war period just passed when mines were producing heavily, a high tax is assessed this year when they are producing nothing at all. The same thing is true of mines which are taxed under the ad valorem system. The ore in the ground is measured and a value is placed thereon, based on the estimated value of future profits. The mine may be unable to operate because there is no sale for its products, but it is still subject to a tax sometimes as high as that which would apply if it were operating at a profit. A few mines, in order to pay their taxes, are forced to continue production, and thus are compelled to take out of their properties only such ore as may be produced at a profit. This results in an enormous waste of low-grade ores.

Excessive and Discriminatory Taxation Retards Mining

The development of the mining industry is essential to the prosperity and development of every mining state. The fact cannot be ignored that there has been an enormous flow of capital, population, and business into every mining state as a result of the opening of vast resources of hidden natural wealth and the growth of mining. Railroads have been extended throughout the mining regions, power plants have been erected, agricultural resources have been made available, and thus the mining industry has created permanent improvements which have added materially to the taxable wealth of the country. Therefore, the necessity for the adoption of a policy which will encourage further development instead of causing waste and depression is evident, and any state which follows a policy of penalizing its mines by imposing on them an excessive and discriminatory tax burden may add so materially to their production costs as to make the extraction and utilization of a large portion of their ores prohibitive.

Taxation Should Not Check Production

One of the first conditions which should govern in the taxation of mining property is that the method of taxation adopted should bear as lightly as possible upon production, so as not to check the flow of profit from which taxes must be paid and the community maintained. Another condition which should be observed in the framing of a tax law is that the tax to be imposed should bear equally upon all classes and individuals, so that no citizen or group is given an advantage or placed at a disadvantage as compared with others. A third condition which should be a controlling factor in the enactment of a tax law is that it should be in certain terms, easily definable and understood, to prevent arbitrary, corrupt, or tyrannical methods of administration on the part of officials. None of the taxation and revenue systems now in force in the various states meets all of these conditions.

The Tendency to Discriminate Against Mines

An analysis of the situation, particularly with respect to state and local taxes, shows that there is a growing tendency in certain states to discriminate against mineral properties and mining enterprises in the enactment and administration of the tax laws. This tendency is disclosed in the movement within some states to impose upon the mining industry different forms of taxation, methods of valuation, and exorbitant rates for the purpose of obtaining a greater amount of revenue from mining property and mining operations than is obtained proportionately from other property and other businesses or industries. The result has been to curtail mining and discourage the development of mineral resources, and is reflected in decreased production, reduced capital, closed mines, wasted ore, and unemployed labor in mining districts.

The tendency toward extravagance in state and local expenditures; the demand for tax-free state and municipal securities which encourages the increase of state and local indebtedness; the prejudice existing in many of the states against non-resident corporations, stockholders, and property owners; the general lack of understanding and non-application of scientific, equitable and economic principles in the administration of tax laws, and the absence of local restraint upon the taxing power in determining the assessment of natural resources whose products are not consumed locally—all these contribute to the difficulties which are encountered by individuals and corporations engaged in the business of mining.

It has been recognized that unscientific and varying methods of taxing mining property in different states and the adoption of new methods of obtaining state revenues without giving due consideration to the relation and effect which such methods may have upon the local industries of the state as compared with similar industries of other states, and without relative consideration of the tax burden as a whole, have resulted in an enormous tax burden which does not spread equitably over every unit of industry and in the creation of a situation where properties in different states cannot be operated on equal terms. That this whole subject might be reviewed by the Government, Senator William H. King, of

Utah, has introduced a joint resolution in the United States Senate, requesting the President to call a conference of representatives of the Federal and state governments to consider questions relative to Federal and state taxation. In addition to the consideration of the relation between Federal and state taxation, co-operation between Congress and the states in the laying of and levying of taxes will be considered, as well as the matter of duplicating and conflicting Federal and state taxes and the means for the accommodation of such conflicts. It is hoped that out of this movement there will be evolved a more equitable plan of mine taxation, and that a fairer and more consistent attitude on the part of the general public and the taxing authorities toward the wasting industries may be promoted.

Capital Diverted by Federal Taxation

Federal taxes do not now constitute a direct oppressive burden upon the mining industry, as they fall only upon taxpayers who are enjoying "net profits"; but indirectly they have an important bearing upon every mining enterprise. The high excess profits and surtax rates have caused vast sums of liquid capital to be diverted from normal channels of investment, including mining investments, into tax-exempt securities issued by municipal, state, or Federal authority, and this capital, needed for replacement, exploration, development, and expansion of industry, is thus removed from the industrial investment pool from which it could be drawn under normal conditions.

The period of depression following the Great War has intensified the disturbing effect of high Federal taxes, which, during the war, increased approximately 1,000 per cent over pre-war rates. However, increased state and local taxes are of the most vital concern, because they are not uniform, as are Federal taxes, vary widely in different states, and do not spread equitably over taxable resources irrespective of class or conditions, even within the confines of each of the states.

Short-sighted for State To Burden Mining Unduly

Any state which imposes an onerous tax burden upon its natural resources whereby production is checked, exploration and development work is discouraged, capital is diverted from the state, and costs cannot be reduced to meet depressed market prices is pursuing a short-sighted policy, is defeating the principles of conservation, and is destroying potential wealth from which future revenues would be derived. This is particularly true of timber and minerals. Laws should be enacted which will adequately safeguard and conserve these rapidly dwindling natural resources, instead of statutes which permit and encourage the speedy exhaustion of timber without any provision for reforestation, and compel the dissipation of mineral reserves, by forcing the exploitation of mining properties, at the same time preventing the development of low-grade orebodies and the discovery of new deposits.

Residents of States Profit Chiefly From Mining Ventures

In justification of discriminatory taxes imposed on the mining industry, it has been contended that natural resources have been exploited mainly for the benefit of non-resident stockholders. To refute this contention it is only necessary to examine the expenditures made by mining companies for wages, fuel, power, freight, supplies, miscellaneous, and taxes within the state. Such an investigation will show that the net surplus left for distribution of dividends to stockholders as a return of capital based on the probable life of the property and as a return of interest on the investment is startlingly small.

That investors in mining properties are entitled to a return of their capital before the properties are exhausted, and that they are entitled to a fair return as interest on their investment, must be conceded by all. Yet it is doubtful whether the annual net earnings of mines, averaged for lean and prosperous years alike, ever will equal the annual loss of capital expended in mining operations. It has been estimated that for every successful mining undertaking there have been ten failures; and the failures represent lost capital which can never be recovered by those whose fortunes were hazarded. States are quick to take advantage of the successful venture, regardless of the years spent by the prospector in seeking the deposit, the money spent in exploration, or the prosperity which is thereby brought to the community; but no encouragement is offered in the event of failure.

In the preparation, enactment, and administration of tax laws, as well as other laws affecting the mining industry, it should be remembered that mineral resources have national and international aspects which have an important bearing upon the economic condition of the country as a whole, and any maladjustment of the tax burden which retards development and limits production is certain to be injurious to the nation.

Sweden's Metal and Mineral Production In 1920

The Swedish Commercial Board has issued a summary of the metal and mineral production of Sweden in 1920. The total production of iron ore was 4,519,112 tons (metric?) or 9.3 per cent less than 1919. The output of other ores and their values is shown in the following table:

	Tons	Kronor
Silver and lead ore	2,901	845,197
Molybdenum ore	0.6	5,400
Wolfram (tungsten) ore	30.5	74,736
Copper ore	1,136	42,530
Manganese ore	14,926	1,312,483
Zinc ore	47,674	2,466,870
Graphite	7	520
Sulphide ores (pyrites)	107,326	3,457,091
		8,204,827

The output of non-ferrous metals was as follows:

	1919 Kilograms	1920 Kilograms
Gold	21	7
Silver	620	359
Lead	827,448	862,850
Copper	3,558,292	1,288,874
Zinc	2,320,538	5,759,500
Sodium metal	109,936	165,096

Bureau Studies New Jig in Zinc District

At the Mississippi Valley Station of the U. S. Bureau of Mines at Rolla, Mo., in connection with the study of mill problems of the Tri-State zinc district, a new type of laboratory jig to study the nature of the ore and various products in the mill circuit has been built. A study has been made of the importance of sizing and other jigging principles, as well as a study of the nature of the ore and the various products in the mill circuit. The development of a chat jig of semi-commercial size may be undertaken. Laboratory equipment is being installed in the Miami, Okla., School of Mines for this investigation.

By the Way

No Local Chapter Here

Robert Benchley, in his new book "Of All Things," discusses the plight of a writer who came to New York from a Middle Western town to make his fortune. "I was already discouraged. I knew no one in the Big City, and had been counting on my membership in the National Geographic Society to find me friends among my fellow-members in town. But I soon discovered that the fraternity spirit in the East was much less cordial than in my home district, and I realized, too late, that I was all alone."

An Arsenical Romance

Forty men with $100 apiece are wanted at once by A. Fenninger, who is, or was, stopping at the De Soto Hotel, Denver, Col. Mr. Fenninger knows where two and a half millions in gold and silver were buried long ago by the early Spaniards and wants help to go and find it. This treasure was hidden 150 years ago in the "wilds of the Arkansas Ozarks" in the White River country, but until Mr. Fenninger found the key, carved in stone, to an ancient map while hunting last fall, its whereabouts was unknown. The tale as he told it recently to the *Rocky Mountain News* runs as follows:

Mind you, I knew nothing of any treasure in the country when I went to Eden's bluff. I was simply on a vacation, out squirrel hunting. Across the river from the bluff and a quarter of a mile east I was pursuing a squirrel and stumbled upon a stone slab, hidden in the tall grass. The slab was covered with strange hieroglyphics. I scraped the dirt and moss from the inscriptions and called a native to see it. Then I heard the story.

I learned that I had accidently stumbled upon the key to the paper map, for which the Spanish government had made extensive search twenty-two years ago, and learned the story of the buried bullion.

Fearful lest the enraged Indians capture back their treasure, the Spanish constructed an underground labyrinth of tunnels and concealed the gold in them.

Years passed. Then, close to the opening of the nineteenth century the Indians, again reinforced, made another and more terrible onslaught upon the Spanish settlers. The white men were unprepared, and a massacre followed, only one youth escaping the murderous redskins.

As near as I can make out, nearly 100 years passed before a regular searching party set out after the gold. They came from Spain with the ancient map and scoured the district in the vicinity of Eden's bluff, but without the stone key to the map, which they were unable to find, they were unable to tell that the gold was far underground.

Ten years or so ago a party of Americans, natives of Arkansas, becoming acquainted with the fact that the immense treasure was buried in the country, began searching blindly for gold.

Accidentally they fell upon the covered passageway to the tunnel and began digging into the gravel. They found a mass of half-rotted timbers interlaced in the dirt, barring further digging. A hole was chopped through and the debris caved in, striking far below with a hollow sound.

One of the men was let down the hole on a rope to investigate. In a few minutes they heard him calling frantically to be pulled up. The man was brought to the surface, muttering in a delirium, and he died two days later without being able to tell what he saw.

Now, said Mr. Fenninger, the natives of this part of the Ozark mountains are very superstitious. This incident wholly unnerved them for further attempt to recover the gold, and even now one could not hire them to venture near the death hole.

It is plain to a scientific man what caused the gold hunter's death. *The action of the damp earth upon such a mass of gold must necessarily generate a great amount of arsenic gas.* It was this gas which killed that man.

By the means of that stone slab covered with hieroglyphics that I stumbled upon while squirrel hunting, I discovered three other stone maps in the fifteen-acre tract east of Eden's bluff, and these maps led me to the old shaft, now caved in and covered with weeds.

My partner, who now owns the land there, and I started to dig again and found unmistakable evidence that this was the main entrance to the old Spanish tunnel. We did not have equipment to penetrate far, and we needed apparatus to neutralize the effects of the arsenic gas generated by the rare gold below before we dared to go in the shaft.

Mr. Fenninger, therefore, has advertised for forty men with ready cash and promises to treat them right. After reaching Arkansas it wont take over twenty days to get the treasure out of the ground, he says.

Caution

A gentleman, thinking of buying a book on blowpipe practice, states that he first wishes to know about what per cent of metal must be in the rock to make the proper separation. We recommend his caution to others. Never attempt to separate the metal from its ore or the ore from its gangue until you first know that you have enough to make the result profitable. Never build a mill until you have ore enough to run it after it is built. Of course, there are exceptions: sometimes a little ore is sufficient to run the newly built mill until all the stock has been unloaded at a fancy figure and all the suckers caught. After this is accomplished it matters little whether the mill runs or not.

More Criticism

A miner's wife, Mrs. Tom McCulla, at the Britannia mines in British Columbia, writes that Mrs. Whitney's statue, "The Engineer," reminds her of one of the men she used to see on Market Street, in San Francisco, looking for "snipes," the position shown being absolutely like theirs as they hunted in the gutters. Mr. McCulla is very fond of chiclets, she adds, and uses them whenever he is in a gassy or smoky place.

Jeffrey A. Houghton, of Magdalena, N. M., calls the Whitney creation "an inefficient effort."

Talking of chiclets reminds us that Wrigley, of chewing gum fame, is said to have purchased a group of mines in the Joplin district for the customary half million dollars. This possibly foreshadows the announcement of a new use for lithopone.

The Old Miner

BY PAUL H. KEATING

Take away the daily humdrum of this sodden life I've known, and replace it with another of a very different tone. Take me far from fuse and powder and the single-jack and drill. Write it out, Old Boy, I'm quitting and I'm going down the hill.

Take me where the wine is flowing and the lager is on tap, where the eyes and cheeks are glowing, and where no one cares a rap; while the strains of some sweet music will turn your head for fair, and it seems you must be dreaming in a world without a care.

Write it out, my boss, I'm leaving and I'm going on a souse that will make the feasts of Ceasar look like living with the cows. But it will not last forever so I'd like to ask you, When I am broke and cold and hungry can I have my job again?

HANDY KNOWLEDGE

A Method for Measuring Leakage in Compressed Air Lines

BY WALTER S. WEEKS
Written for *Engineering and Mining Journal*

This paper is a discussion of a method for determining the number of cubic feet of free air that leaks from an air line each minute when the receiver pressure is held constant at the usual mine pressure. The measuring device is the low-pressure-orifice meter that is ordinarily used for testing compressors. A sketch of this meter and its connections to the receiver is shown in the figure.

The meter is connected to the receiver in the air-compressor room. The air flows from the receiver through the valve *A* into the tank *B* and then out through the orifice *F*. At the point *D* the pressure is taken with a water manometer *E*. The temperature in the tank is taken with a thermometer at *C*. The orifice is carefully made with a smooth, rounded inner surface. A complete description of the meter, with a chart for quickly determining the flow, is given in an article previously published.[1]

The leakage is determined as follows: Close the valve *L* on the air line so that there is no connection between it and the receiver in the compressor room. Select one compressor (if there are several compressors) whose capacity is greater than the leaks. Adjust this compressor so that it will not unload at the pressure at which the test is to be made.

Now, run this compressor and discharge all of the air through the orifice. Adjust valve *A* until the compressor holds exactly the desired pressure. When the pressure remains constant at this value, a reading of the meter shows how much air the compressor will deliver at that pressure. This amount will be constant as long as the receiver pressure is constant.

Now, open the valve on the air line to the mine. The air line and meter are now in parallel. Adjust valve *A* until the pressure in the receiver is constant at the desired value. The compressor is now delivering the same amount of air that it was delivering when all was discharged through the orifice, but some of the air is leaking from the air line and the rest is going through the orifice. A reading of the meter shows how much is passing the orifice. The difference between the first reading and this reading is the amount that is leaking from the air line.

Example: The air is measured as free air.

	Cu.Ft. per Minute
Meter reading, all air through orifice	500
Meter reading, meter in parallel with air line	300

Leakage 500 — 300 = 200 cu.ft. per minute.

If the air line is very long, it will take a little time to determine whether the air pressure in the receiver has become constant.

Let it be assumed, for example, that the air line consists of 20,000 ft. of 6-in. pipe and that the receiver in the compressor room has a volume of 1,000 cu.ft. The total capacity will be 5,000 cu.ft.

Let it be further assumed that the value to the orifice has been adjusted so that the compressor will deliver 10 cu.ft. more air each minute than is discharged through the leaks and through the orifice. This excess air will increase the pressure. How long will it take this excess air to increase the pressure 1 lb. per sq.in.? Assume the barometric pressure to be 15 lb. per sq.in. absolute.

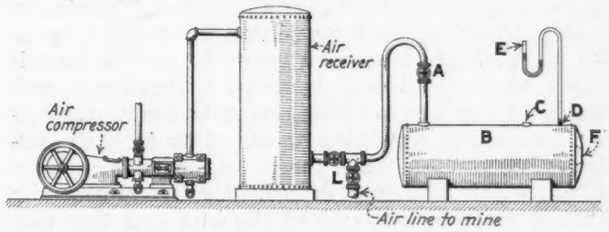
$$V_{at} = \frac{(P_1 - P_2)\ V}{15}$$

For derivation and discussion of this formula see the article[2] in the June 11 issue of *Engineering and Mining Journal.*

V_{at} is the free air necessary to change the pressure.
$(P_1 — P_2)$ is the change in pressure.
V is the volume of the receiver and line.
Units are cubic feet and lb. per sq.in.

$$V_{at} = \frac{1 \times 5{,}000}{15} = 333$$

Now, if it takes an increase of 333 cu.ft. of free air to change the pressure 1 lb., it will take the excess



ARRANGEMENT OF APPARATUS FOR TESTING AIR LINE

of 10 cu.ft. per minute thirty-three minutes to produce this change. It will actually take less time than this because the compressor puts hot air into the line, whereas this formula assumes constant temperature.

A good recording gage can be easily read to the nearest pound, and smaller changes can be detected, so in this test if one watches the gage for fifteen minutes one could probably tell whether or not the pressure was constant. Obviously, the larger the air line the longer one must watch the gage.

Suppose the purpose be to determine the leakage in a large underground receiver. First, run a test on the leakage of the line with underground receiver disconnected. Then run a test on the air line and receiver together. The difference in the two amounts of leakage is the leakage in the receiver.

Assume that the volume of the line, the surface receiver, and the underground receiver is 30,000 cu.ft. How long will it take an excess of 10 cu.ft. per minute to raise the pressure 1 lb?

$$V_{at} = \frac{1 \times 30{,}000}{15} = 2{,}000$$

It will take the excess about 200 minutes to raise the pressure 1 lb. A change might possibly be detected in an hour.

While a test is being run all conditions must, of course, remain constant. The compressor must run at constant speed and all the valves in the mine must be be kept closed.

[1] "Testing an Air Compressor," by Walter S. Weeks. *Mining and Scientific Press*, Vol. 116, p. 479. April 6, 1918.

[2] "Air-Receiver Calculations," by Walter S. Weeks. *Engineering and Mining Journal*, June 11, 1921.

THE PETROLEUM INDUSTRY

Prospecting for Oil With the Diamond Drill

BY J. S. MITCHELL
Written for *Engineering and Mining Journal*

DURING the last year or two there has been a gradual change in the method of prospecting and developing new oil lands. For many years this class of work was left almost entirely to "wildcatters," the larger companies buying the oil as it was produced or taking over the wells or properties after they reached the producing stage. The oil industry owes much to the wildcatter. Had it not been for him and his unbounded optimism the oil industry would have lagged many years behind its present state of development. Much ridicule and abuse has been heaped upon the head of the wildcatter. He is a shrewd foresighted business man when the oil comes in, but in failure has a good chance of being called a fool or a swindler. The pioneer in oil prospecting, like the gold prospector who takes to the hill with grubstake and burro, is sure to be followed, when a discovery is made, by promoters and confidence men who are little concerned about prospecting, their chief aim being to sell stock in their particular enterprise. When the promotion is on a large scale, a well is sometimes drilled. The well is generally large in order to take care of the enormous flow that is promised. In locating the hole, geology and engineering study are of little importance but in some miraculous way the hole is known to be just above the oil sands when more money is needed.

LIMITATIONS FOR PERCUSSION-TYPE DRILLS

In the past the average depth of holes was much less than it is today. As the depth of hole has increased the drilling equipment has been enlarged and strengthened to handle the greater load, but in most respects the standard or rotary rig has undergone little change. For depths up to 700 or 1,000 ft. in formation favorable for its use the percussion-type drill is more efficient than any other, but in very deep holes the cost mounts rapidly due to the necessity of using casing not only to hold back caving material but to cut off water when encountered. When water stands in the hole the blow of the tools is retarded through the cushioning effect and friction on the line. Where it is desired to carry a hole to a great depth the usual practice is to start with very large casing in order to provide for a number of lines to be set as conditions demand. When long heavy lines of casing are necessary and the working strains are greater, more accidents occur resulting in considerable delay and expense fishing for casing or lost tools.

The rotary drill in sand or very soft formation attains great depths without long lines of casing by using mud fluid to plaster the walls and through its weight counteracts the inward pressure of the walls of the hole. In drilling through formation that contains little hard rock the rotary drill is most efficient.

It is at its best when drilling for oil sands of known depth so that casing can be set at the proper time and avoid the danger of sealing off the sands with mud fluid. In prospecting virgin territory where the depth of the oil sands is unknown the driller must be careful to avoid passing through oil without knowing it. In some instances in Texas, oil sands have been located by analysis of cuttings taken at fixed intervals while drilling, although there was nothing to indicate that the drill had passed through oil.

SYSTEMATIC EXPLORATION REQUIRED AT PRESENT TIME

Luck played a much larger part in the prospecting of the past than it does today. The hit or miss method is gradually giving way to a systematic study of geological conditions. Forced by a combination of circumstances to take a hand in exploration and production, the larger companies are bringing to bear that same painstaking study and investigation that have accomplished such wonders in oil refining. Deep work in remote sections of this country or foreign lands called for expenditures that could only be provided by strong companies, and these companies, realizing that their future depended on new fields to take the place of depleted territory, are building organizations for conducting exploration work on a large scale. For much of this work in unproven fields the diamond drill has the advantage over other types as it is a much lighter outfit and produces a core of all solid material penetrated. It is possible with the core to identify the various strata beyond a doubt, thus determining whether or not the hole is in favorable formation and at what point oil would be reasonably expected. Diamond-drill holes of from 4,000 to 6,000 ft. in depth are not uncommon and the possibilities of trouble in drilling great depth is not increased in the same ratio as with cable tools, neither does the weight of outfit for greater depth increase in the same proportion. This is an important consideration particularly in remote sections. A cable rig equipped with casing for a depth of 3,000 ft. weighs from 125,000 to 250,000 lb., depending on the formation. In the fields south of Tampico, Mexico, rotary outfits with cable equipment and camp added have amounted to 250 tons. Moving this amount of equipment through rough country and drilling one prospect hole 2,500 ft. deep means an outlay of around $150,000 for operating costs.

A diamond drill outfit complete for a hole of the above depth will weigh from 50,000 to 60,000 lb. and if equipped with sectional boilers may be knocked down for handling on mule back. In principle the diamond drill resembles the rotary drill more than the standard rig. Hollow flush coupling rods are used and the drill itself is a self-contained unit so arranged that the rods

are rotated and raised or lowered by a hydraulic cylinder acting direct from the line of rods. The hoist is also an integral part of the machine. In the larger size both the hoist and the hydraulic feed cylinders are capable of handling from 30,000 to 40,000 lb. of drill rods. When drilling at great depth all excepting about 900 ft. of rods is carried by the hydraulic cylinder and at no time is the full weight permitted to rest on the diamond bit. The rotating speed averages around 250 revolutions a minute and the feed from five to eight feet per hour while drilling solid rock. In soft material a fish-tail bit and mud fluid are used the same as with the rotary. The drilling speed or rate of advance in loose material is somewhat less than the rotary, but the speed in hard rock is greater than either the cable or rotary rigs, and the harder the rock, the greater the advantage in cutting with diamonds.

Per Foot Cost of Diamonds Low

The initial cost of diamonds is high, but the cost per foot of drilling is comparatively small. The bit usually consists of eight stones weighing from 2½ to 3 carats each. The best grade, which is the most economical to use, sells at $125 per carat, making a cost of from $2,500 to $3,000 for the bit. The per foot cost for diamonds in ordinary oil formation averages between 25c. and 30c. The diamonds are the black, apaque, non-crystalline variety known as carbon and are found only in Brazil. These are set in a soft-iron bit by drilling and cutting holes of suitable size and shape, then drawing the metal close around them with caulking tools. All stones are set to cut on the face, but four are set to cut clearance on the outside and four to cut clearance on the inside.

One criticism of the diamond drill in oil work that is often made is that it does not drill a large hole. There is no mechanical reason why it cannot drill a large hole, but in prospecting or drilling to locate oil, a two-inch core from a three-inch hole will give as much information on geological conditions as a large hole and will give far more information than the non-coring type of drill regardless of size of hole. Drilling a larger hole would call for larger and heavier equipment, which is unnecessary when it is desired to prospect with a view to locating an oil pool rather than prepare for a larger production. In exploration work, the important thing is to locate oil. The diamond drill is primarily intended for work of this kind and particularly well adapted for it, as it furnishes absolutely accurate data of underground conditions at a minimum cost.

Some of the diamond drills now on oil drilling are equipped with fittings for four-inch casing and drilling in with 3⅝-in. bit, although this is not the maximum size that may be used. It is large enough to take care of considerable production. The production of the majority of wells can be handled easily through a four-inch pipe. In the Mexican field where pressures are high a four-inch pipe will take care of from 25,000 to 50,000 bbl. of oil a day, depending on depth, temperature, percentage of gas and viscosity. Just how much the size of pipe has to do with the production of the well is difficult to determine. In a pumping well there is little advantage in having a casing larger than necessary to take care of production. In a high-pressure well the size of casing will have some effect on production, but the amount of flow depends more on the porosity of rocks or capacity of channels leading to the point of contact with the casing. The friction in the larger casing is less, but if the flow to the casing is less than the capacity of the casing a smaller line will serve as well. If the size of casing determined the production of a well, an eight-inch well would produce four times as much as a four-inch well and this is certainly not the case.

One reason that it has been the practice to drill large wells is that neither the rotary nor the standard rig can drill a hole smaller than six inches efficiently, and with the standard rig it is necessary under some conditions to start holes twenty inches in diameter in order to provide for the necessary lines of casing to cut off water. Assuming a hole is enlarged at the bottom a casing is simply a flow line to the surface, and there is no good reason why it should be larger than the surface flow line, except in pumping wells where the casing must be large enough to operate the pump properly. One interesting feature of the diamond drill is the method employed for controlling high gas or oil pressures when drilling or removing rods. An oil saver or packing box is provided with a series of cup leathers designed for high pressure. The rods, having flush joints, pass through the packing box, making a safe, tight joint to take care of any pressures that may be encountered suddenly. When it is desired to remove the rods under pressure a sheave wheel is attached to the top of the rods. The hoisting rope is passed through a sheave at the floor, then over the sheave on the rods and the end of the rope attached to the floor on the opposite side of the machine. The rods are then allowed to rise under control of the hoisting brake and are removed in ten-foot sections, being held by the chuck while each length is removed. With this arrangement it is possible to raise the bit to a point between the valve and the packing box, after which the valve is closed and the packing box removed.

The application of diamond drills to drilling large holes has been given some consideration, but in all probability the maximum size will be somewhere between four and six inches. From a purely mechanical standpoint it is a simple matter to increase the size of hole, but this would mean a heavier outfit and consequently higher operation and transportation costs. The field of the diamond drill is in prospecting; or in drilling producing wells where a casing of about four inches will take care of production. It is particularly well suited to deep prospecting and it is in these fields that it will be generally used. Where a large hole is desired, and oil is known to exist, such as in offsetting wells, drills which cut large holes are better adapted.

It is not claimed for the diamond drill that it is destined to supplant the rotary or standard rig in all classes of work. There is a field for each, but the diamond drill is rapidly establishing itself as an aid to geologists in conducting oil exploration work accurately and intelligently, and up to certain limits it will be used for drilling producing wells. This is particularly true of deep work or when drilling in remote sections where roads or facilities for transportation are poor. Diamond drills are used in the oil fields of Illinois, Oklahoma, Texas, Wyoming, Washington, California and Mexico. Although the formations vary from the soft upper strata in Mexico to the hard lava in Washington, no unusual difficulty has been encountered in completing holes in any of these fields. The deepest hole drilled to date was to a depth of 5,000 ft. in southern Oklahoma. This work was done on contract by the Sullivan Machinery Co.

Book Reviews

The Metallurgy of the Common Metals. Fifth Edition. By Leonard S. Austin. Cloth; 6 x 9; pp. 615. 1921. John Wiley & Sons, Inc., New York. Price, $7.

This book is a descriptive treatise on the essentials of metallurgical practice in the United States. The introductory chapters on general metallurgy are devoted to short discussions of fuels, refractories, ore dressing, metallurgical furnaces, combustion, metallurgical thermo-chemistry, roasting, and concentration. Some of these chapters are necessarily very brief, and the subjects are mentioned only to show their application to or effect on the metallurgical processes discussed further on in the book. Following this introduction come sections on gold, 107 pages; on silver, 50 pages; on iron and steel, 66 pages; on copper, 107 pages; on lead, 54 pages; and on zinc, 27 pages. The remainder of the book contains chapters on plant and equipment and their costs and on the business of metallurgy.

The need for a work of this kind is shown by the fact that the present volume is the fifth edition, the first having appeared in 1907. Since then many improvements, including both additions and eliminations, have been made, so that now the book gives a good general idea of present American metallurgical practice. It is evidently designed principally for student use or for general reference purposes, for the treatment is not sufficiently thorough to be of much value as an aid to the operator. However, it is surprising how much material, on such a variety of subjects, can be included in a book of this kind. Not only are processes described, but many descriptions of individual mills are given, types of machinery are illustrated and briefly mentioned, costs are liberally presented, and Professor Austin even has something to say on economics, the handling of men, accounting, and company organization. Students should be taught to give some attention to all of these matters. Many of the chapters are concluded by a paragraph giving a useful summary—an excellent feature.

The best of books covering a wide range of subjects offers many opportunities for criticism by specialists, but there are some things which are hard to excuse. Never before have we seen a technical book containing so many evidences of general carelessness in its preparation. One would think the proof was read by an office boy, so numerous are typographical errors. Many of the figure references lead the reader on a wild-goose chase. The climax in this respect was reached on page 388, when reference is made to Fig. 29 as an illustration of a hand-reverberatory roaster. Fig. 29, on inspection, proves to be a cut of a "tailings sampler" printed upside down. Hundreds of other minor errors distract the reader's attention like a swarm of gnats. Weightier errors are less numerous. Costs, though freely given, are sometimes meaningless because the date is not given. There is a tendency throughout the book to describe a process in terms of the practice at a particular plant without letting the reader know that the description is not general. The capacities of machines, analysis of materials, and other such data are for this reason usually expressed within much too narrow limits.

In other ways the information given would be improved by statement in less detail. That the United Eastern mill cost $133,539.09 is no doubt interesting to a bookkeeper, but we cannot refrain from the thought that possibly one of the carpenters stole two pounds of nails to build his chicken house and that the cost should really have been $133,538.98. The citing of such detailed data is particularly noticeable when the information given is not up to date. Porcupine metallurgists will be interested to hear that the Hollinger mill "treats 499 tons of $20 ore daily, recovering 93 per cent of the gold." But perhaps we are giving undue emphasis to these details.

After all, the book is not an unwelcome addition to our library, and we shall no doubt find it valuable many times for reference. E. H. R.

Battlefields of the World War. By Major Douglas Johnson. Cloth; pp. 648. Oxford University Press, American Branch, New York; 1921. Price, $7.

The title page states that this work is a study in military geology. As such, it would be difficult to overpraise the masterly and patient delineation of surface physiographic and geologic features, the influence of each upon military operations, and the story of the military operations themselves related from the physiographer's point of view. The book is a history of military operations, and in so far may be classed as a systematic history of the operations on the several battle fronts studied.

Major Johnson's book will doubtless be worthy of the position of a classic, as a basis of study for future students; then students will be, first, students of military science, for whom the book is evidently primarily intended; next, perhaps, to the historian, for it presents a new analysis of history; and hardly less, perhaps, to the physiographer himself, who, though he will find here no treatise on physiography, nor any statement of new findings in that science, will be enlightened and instructed by the revelation of the vast influence of the minor wrinkles of the earth's surface on the destiny of mankind, and will be urged to a closer scrutiny of them and their origin. J. E. S.

Technical Papers

Air-Lift Pumping—*Engineering* for Sept. 23 (35 Bedford St., Strand, London, W.C. 2, England; price, 1s. 4d.) contains a four-page article devoted to theoretical conditions concerning air-lift pumping and the results of experiments made with a view to ascertaining the most efficient design for an air-lift pump for lifting acid mine liquors in the mine of San Domingos, in the south of Portugal. In the latter part of the paper the installation finally adopted is described, and lists of tests are given showing that it is quite possible to get pump efficiencies with air lifts of between 60 and 70 per cent.

Keno Hill, Yukon—A report on the silver-lead ore deposits of Keno Hill, in the Mayo district of the Yukon, forms a portion of the Summary Report (Part A) of the Canadian Geological Survey, for 1920. (Obtainable on request to the Survey at Ottawa.) The ores are rich and the veins numerous, but their depth is problematical.

Mineral Fuels—"Part II, Mineral Fuels," has recently been published as Bulletin 716, "Contributions to Economic Geology," by the U.S. Geological Survey, Washington, D. C.; obtainable on request. The issue contains a number of short papers describing areas on which probably no other report will appear. Maps and illustrations are included. Contents are as follows: "Geology of Alamosa Creek Valley, Socorro County, N. M."; "The Upton-Thornton Oil Field, Wyoming"; "The Mule Creek Oil Field, Wyoming"; "Natural-gas Resources Available to Dallas and Other Cities of Central North Texas"; "The Lance Creek Oil and Gas Field, Niobrara County, Wyoming"; "Coal in Eastern Idaho"; "Coal in the Middle and Eastern Parts of San Juan County, N. M."; and "Character of Coal in the Thomas Bed Near Harrison, W. Va."

Oil Shales—An eighty-page book entitled "Oil Shales" has been prepared by H. B. Cronshaw, and is published by John Murray, Albermarle St. W., London; price, 5s. net. The issue was prepared under the direction of the Mineral Resources Committee of the Imperial Institute, with the assistance of the scientific and technical staff. The contents include the occurrences, characters and uses of oil shales, and sources of supply in the British Empire and foreign countries.

Roasting Furnace Development—In *Mining and Metallurgy* for December (29 W. 39th St., New York; price, $1) Arthur S. Dwight has a five-page article on the evolution of mechanical roasting in which is described some of the early difficulties of hand roasting as well as a few comments on the development of the O'Hara, Brown, Ropp, Wethey, Spence, McDougal, Pearce, Brückner, H. & H., Godfrey, and Dwight-Lloyd furnaces.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Geological Organizations Meet at Amherst, Mass.

Society of Economic Geologists, Geological Society of America, Mineralogical Society of America, Paleontological Society of America and Association of State Geologists Hold Three Days' Session—New Officers Elected—Summaries of Papers

THE SOCIETY OF ECONOMIC GEOLOGISTS held a most successful meeting at Amherst, Mass., Dec. 28-30, together with the Geological Society of America, the Mineralogical Society of America, the Paleontological Society of America, the Association of State Geologists, and other organizations. The following officers of the Society of Economic Geologists were elected for 1922: President, Waldemar Lindgren; vice-president, Ralph Arnold; new councillors, James F. Kemp, and C. K. Leith. Charles Schuchert was elected president of the Geological Society of America for 1922.

The presidential address of the retiring president of the Society of Economic Geologists, Dr. R. A. F. Penrose, Jr., was on the subject "The Society of Economic Geologists, Its Sphere and Its Future" and outlined the scope and necessity of the society, its international character, and the growth of the profession of economic geology. A vote of thanks was given to Dr. Penrose for his "energy, devotion, and wisdom during his incumbency as president."

J. E. Spurr, speaking for the Committee on Political and Commercial Geology of the society, called the attention of members to the work which is in progress under the auspices of the Mining and Metallurgical Society of America, on the subject of a national policy for the efficient management of our mineral reserves. A motion was then carried by the meeting to ask the secretary of the society to call the attention of each member to the importance of the subject, and ask his aid.

CLEAR WRITING ADVOCATED

Dr. George Otis Smith, Director of the U. S. Geological Survey, read a paper on "Plain Geology," which embodied a plea for the use of plain English and the elimination of complex and unnecessarily ponderous terminology in geologic writing. Many amusing instances were given where the translation of sonorous terms in a manuscript to the simple equivalent, revealed behind the term only an insignificant thought.

Dr. Waldemar Lindgren read an interesting paper by himself and Prof. E. S. Bastin on "The Geology of the Braden Mine, Chile." At the Braden is a volcanic chimney or pipe some thousands of feet in diameter, breaking through andesite porphyry. The ore deposits occur on the margin of the pipe, fading away into the andesite. The ores are predominantly of copper, with much tourmaline in the gangue. A high-temperature deposit very near

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the surface is demonstrated. The commercial ores of copper have been concentrated from this early mineralization by descending waters. The period of enrichment (chalcocitization) was earlier than the development of the present mountainous topography, and the enriched zone is now in process of destruction by the active erosion.

METHODS OF TEACHING ECONOMIC GEOLOGY

Prof. E. S. Bastin read a paper on "Stressing Economics in the Teaching of Economic Geology." The relation of ore deposits, their distribution and exploitation, to commercial and political problems and policies were brought out, as was the need of including these aspects and considerations in instructing students in the important phases of geology. The development of the knowledge of these truths under the stimulus of the World War was touched upon, and the growth of a literature instanced by the volumes on "Strategy of Minerals" edited by G. O. Smith, "Political and Commercial Geology," edited by J. E. Spurr, and "The Economic Aspects of Geology" by C. K. Leith, was sketched out. The aggregate production of minerals in the world in the last twenty-five years has probably been greater than in all previous human history. Therefore, in teaching geology, full attention should be given to the relation of mineral resources to mankind.

A series of interesting and constructive papers on the general subject of oil production were presented, by Prof. Roswell H. Johnson, Orren W. Skirvin, and Robert B. Bossler. Prof. Johnson's paper ("The Oil and Gas Section of the Course in Economic Geology"), referred primarily to the teaching of these problems to students. He believed that a course in oil geology should consider the chief supply factors governing value, the conditions causing financial losses and failures, and reserves. Each of these divisions was analyzed and discussed. Mr. Skirvin's paper ("Experimental Study of the Invasion of Oil into a Water-Wet Sand"), discussed the relation of capillarity to the invasion by oil or water of a sand, and showed that experiment had demonstrated that in such invasions the fluid was contained in the larger pores, so that the rôle of capillarity was much reduced over what it was currently supposed to be. Mr. Bossler's paper discussed "Results Obtained by Improved Methods of Extracting Petroleum." The processes of flooding as conducted in the Bradford Pool were discussed, and those of dewatering in the Petroleum Center-Oil City region; and some data were given on the Smith-Dunn process. The principles underlying these methods were discussed; and also the effect of well spacing per acre on well yield, and some of the various methods of initiating a flood.

Prof. L. C. Graton, of Harvard University, read a brief paper on the "Probable Origin of Certain Vein Structures." He referred to "brecciated" veins, or the inclusion of angular rock fragments in vein material. He believed it was generally held that these fragments were the result of shearing or dislocation of the two walls; but the phenomena of the discharge of broken rock fragments into mine drifts by spalling — in the lower levels of the Calumet and Hecla copper mines—led him to question whether such a process might not take place in vein fissures also. Reverting to the theory that in certain cases vein fissures may have been held open by the pressure of the vein-forming fluids, he queried whether such discharge of broken rock fragments might not take place also under these conditions, at a certain critical elevation, with decreasing pressure of overlying rocks.

Prof. Waldemar Lindgren, of the Mas-

sachusetts Institute of Technology, read two short papers. One, on "A Recent Hot Spring Deposit in Bolivia," described a tufa deposit around a hot spring. The tufa contains much barite and manganese oxide (psilomelane) and, what is very unusual, up to 2 to 3 per cent of tungsten, probably in a colloidal state within the psilomelane. Certain older veins in the vicinity carry a certain amount of the tungsten mineral hübnerite. The springs have a moderate temperature, and are a mile or two away from important tin mines. Prof. Lindgren also read a short paper on "A Suggestion for the Terminology of Certain Ore Deposits" in which a num- of new and precise terms, mainly of Greek derivation, were proposed for ore deposits—such terms as pyrometasomatic, nesothermal, etc. In the discussion opinion differed as to the advantage to be gained by further nomenclature.

Ore Deposits of Leadville, Col.

On Thursday, at the afternoon session, G. F. Loughlin, chief of the Mineral Resources Division of the U. S. Geological Survey (who is at the final task of bringing to a completion the Leadville monograph, which has been in course of preparation for nearly thirty years, first by S. F. Emmons, and then by J. D. Irving), presented a very interesting paper on the "Ore Deposits of Leadville, Colorado." Mr. Loughlin pointed out that previous to the heavy post-mineral faulting at Leadville, there were pre-mineral reverse faults of slight magnitude, as notably instanced in the Maid fault, discovered by Spurr in 1907, and its probable extension, the Tucson fault, detected by Leadville engineers in 1910. These faults have served as channels for the ascending ore-bearing solutions, and ore deposition has taken place especially where they were dammed back by difficultly previous layers, such as porphyry sills, etc. Fissure veins were also described, passing above into bedded replacement deposits. The heavy post-mineral faulting was outlined, and finally the question of the ore-reserves of the district was discussed.

Replacement Deposits at Homestake

J. J. Runner read a most suggestive paper on "The Gold-Bearing Commingtonite Schists of the Black Hills." The gold ores of the Black Hills occur largely in this folded bed of cummingtonite schist, which is a replaced magnesian limestone. Tourmaline is a frequent gangue mineral of the ores, which are referred, by Mr. Runner, to a magmatic origin, and believed to be part of the phenomena attending the intrusion of the nearby Harney Peak granite. Mr. Runner's description indicated that the Homestake gold ores are high-temperature replacement deposits of magmatic affiliations.

W. C. Bowen, in a paper entitled "Petrographic Notes on the Franklin, N. J., Zinc Ores," dealt with the problem of the genesis of these most puzzling deposits. His results militated against the theory that these deposits have been altered by pressure and heat from some original, probably sulphide, form. Discussion revealed, however, a wide divergence of opinion as to this problem.

Prof. E. S. Bastin read a paper on "Primary Native Silver Ores Near Wickenburg, Ariz., and Their Bearing on the Genesis of the Silver Ores of Cobalt, Ontario." The Monte Cristo mine at Wickenburg contains rich ores in which native silver is associated with cobalt and nickel arsenides. Study of polished ore specimens shows that the native silver, which is the dominant silver mineral, is wholly primary. This instance strengthens the belief that the native silver of Cobalt also is primary, as has been held by several writers, although the earlier view was that these were secondary, and the result of alteration of surface waters.

Continuous Mapping Plan Advocated

F. W. De Wolf, State Geologist of Illinois, read a paper on "The Need of Expediting Topographic Mapping of the United States." He called attention to the economy resulting from the use of topographic maps in the prosecution of public works, such as road-building, drainage, municipal water supply, irrigation and other public engineering projects; and pleaded that the program of the U. S. Geological Survey in completing its topographic map of the United States should be assisted as much as possible. For this purpose the Temple bill has been introduced into Congress, providing for a continuous program sufficient to map the country in about twenty years. Every effort should be made to offset the expected economy plea by the proof that it will be truer economy to hurry the work. On the conclusion of Mr. De Wolf's talk, a motion was passed by the meeting, asking the secretary of the society to call the attention of members to this matter.

At the Friday (Dec. 30) meeting of the society, an interesting paper was presented by M. E. Hurst on "A Study of the Supergene Processes at Neihart, Mont." This rather cryptic title preceded a clear demonstration of the primary origin of the rich silver mineral polybasite at Neihart. Discussion brought out the growing perception of the error indulged in by many geologists that rich silver sulphides were necessarily secondary, and due to secondary enrichment, although Spurr had early shown that at Aspen the polybasite was primary, and that rich primary silver sulphides (including polybasite) were more important at Tonopah than the secondary silver sulphides, a conclusion which was afterward checked up by Bastin. The discussion further showed that this common error was being corrected largely by the work of students of ores under the microscope.

H. C. Boydell described "Some Etching Tests on Pyrrhotite"; an interesting paper by Sydney H. Ball was given by A. M. Bateman, editor of *Economic Geology;* T. L. Watson, State Geologist of Georgia, presented a paper on "Geology of the Virginia Emery Deposit"; and R. W. Stone of the U. S. Geological Survey discussed "The Domestic Magnesite Industry in 1921."

The retiring president of the Geological Society of America, Prof. J. F. Kemp, took for his theme the growth of the present almost universally held magmatic theory of ore deposition, and traced its development, largely through the studies and writings of Kemp, Lindgren, Spurr, and other investigators, to its present general acceptance.

Tri-State Branch of American Zinc Institute Elects Officers

John W. Newton, of Miami, Okla., manager of the Commerce Mining & Royalty Co.'s properties in Oklahoma, was chosen president of the Tri-State branch of the American Zinc Institute for the coming year by the recently elected board of directors. D. F. Haley and E. Elam Hall were chosen vice-presidents, and Richard Jenkins, secretary-treasurer.

Mr. Newton has had wide experience in the Tri-State field. He succeeds A. M. Gaines, manager of the Kanok Metal Co., who was not a candidate for re-election. Mr. Haley is manager for the Chanute Spelter Co., a subsidiary of the American Metal Co., and Mr. Hall is manager for the Service Belt Co. and an ore buyer for the Athletic Smelting & Refining Co. Mr. Jenkins has been secretary of the organization since it was started and is given credit for a large portion of the success that it has achieved.

The following committees were named by the new president for the coming year: Roads—Charles Wells, C. E. Hall. M. W. Latimer, F. N. Bendelari, and F. C. Wallower; hospital—A. M. Gaines, M. F. Owen, and W. H. Trapp; program—P. R. Coldren, H. B. Cobban, M. W. Latimer, D. F. Haley, and J. G. Horgan. Other committees will be named later.

New Mines Experiment Station at Minneapolis

Ground was broken for the new Mines Experiment Station of the University of Minnesota and the North Central Experimental Station of the U. S. Bureau of Mines on Dec. 17. This will be, without exception, the best laboratory in the world for the study of iron and manganese ores. The building is of factory type construction, and no pains have been spared in making it convenient and flexible. It is not in the least ornate or elaborate, but is designed for the purpose of furnishing suitable laboratories that will not become antiquated as time advances. C. H. Johnston, of St. Paul, Minn., is the architect. The entire building and mechanical equipment will cost approximately $300,000, $20,000 additional be-

ing available for laboratory apparatus and equipment. The general arrangement includes laboratories, offices, ore bins, and sampling, screening, and crushing machinery. A ten-ton elevator connects all floors. The general construction is brick and concrete, steel and slate roofs, and concrete and asphalt mastic floors. The mechanical equipment includes high- and low-pressure steam lines, high- and low-pressure air lines, high- and low-vacuum lines and pumps, and the building is provided throughout with gas and electricity.

Duty on Crude Oils Decried by Fertilizer Interests

Every effort has been made by the fertilizer industry to impress on the Senate Finance Committee its contention that the movement for a duty on crude oils is inspired by the producers of the Midcontinental fields and that these oil producers would not be able to extend their market greatly, even if they were granted the rate of duty which they are asking. On the other hand, it is contended that such a duty would add materially to the costs of preparing fertilizers and in that way affect the general prosperity by discouraging further their use.

C. H. MacDowell, the president of the National Fertilizer Association, pointed out to the committee that during the past season there was a decline of 50 per cent in the use of fertilizers. This, he pointed out, means a primary loss of 2,000,000 tons of freight to the railroads in the South alone, to say nothing of the potential crop tonnage, which such a quantity of fertilizers would develop.

A duty on oil, it was declared, not only affects costs through increasing the amount necessary to pay for fuel at fertilizer plants, but it adds to the cost of phosphate rock, as oil is used as fuel by companies conducting phospate operations.

Introduction of fuel oil in industry, said Mr. MacDowell, greatly stimulated the use of Mexican oil, to the advantage of both producers and consumers, but since the heavy crude of Mexico is much better adapted for fuel purposes than is the lighter and better quality oil of the Midcontinental field, it is certain that this business can not be acquired by the midcontinent producers. He expressed the opinion that the present demand for a duty on crude oil arises from the fact that the general industrial depression has caused a decrease in the consumption of domestic oil. The period of depression is passing and Mr. MacDowell tells the Finance Committee that unquestionably the oil industry shortly will regain the position it occupied not more than a year ago, when demand exceeded supply, and when there was no point or purpose in having a tariff imposed on imports.

MEN YOU SHOULD KNOW ABOUT

Charles Stewart, ex-Premier of Alberta, has been appointed Minister of the Interior and of Mines in the new Canadian government.

J. H. Stovel, mining superintendent for the E. J. Longyear Co., has been made manager of the mining department, effective Jan. 1.

A. W. Ambrose, chief petroleum technologist of the Bureau of Mines, is making a short field trip to California, in connection with the oil leasing work.

J. A. Campbell, former M. P. for Nelson, Manitoba, has been appointed acting Commissioner of Northern Manitoba in place of **R. C. Wallace,** who has retired from the position.

Francis C. Lincoln, director of the Mackay School of Mines, and **S. C. Lind,** superintendent of the U. S. Bureau of Mines experiment station, of Reno, are inspecting the mines of southern Nevada.

H. H. Hill, superintendent of the petroleum experiment station, Bartlesville, Okla., is in Washington at the present time, obtaining information relating to the investigation which he is conducting with **F. B. Tough** concerning the price for Salt Creek, Wyo., crude oil.

Edwin Higgins was elected president of the California Metal and Mineral Producers Association for the ensuing year at a meeting of the Board of Directors held Dec. 28. Other officers elected were as follows. **W. J. Loring,** first vice-president; **P. C. Knapp,** second vice-president; **W. G. Devereux,** third vice-president; and **Rober I. Kerr,** secretary-treasurer.

H. F. Mason has resigned as petroleum economist of the U. S. Bureau of Mines. Mr. Mason inaugurated some three years ago the compilation of the bureau's monthly statistics of the production and consumption of the various refined petroleum products, and has built up this work to its present state of efficiency. He is leaving the Federal service to accept a position with the American Republics Corporation in New York. His successor will probably be **Harvey J. Lowe,** of Houston, Tex., now an engineer with the Humble Oil and Refining Co. Mr. Lowe has been associated with various branches of the oil business for a number of years and was formerly purchasing agent for the Oil Issues Co.

Mining and metallurgical engineers visiting New York City last week included: **M. H. Bissell,** Bryn Mawr, Pa.; **R. G. Hall,** Namtu, Burma; **W. A. Waldschmidt,** Cambridge, Mass.; **K. S. Twitchell,** Estanbas, Portugal; **Chester A. Fulton,** Baltimore, Md.; **E. N. Cooper, Jr.,** Camp Hill, Pa.; and **A. D. Harvey,** Merrick, N. Y.

SOCIETY MEETINGS ANNOUNCED

New York Section of A. I. M. E. will hold the January meeting on Jan. 11 at the Machinery Club, 50 Church St., following the regular informal dinner. The subject of the evening will be "Compulsory Licensing of Mining Engineers," the speakers being B. B. Gottsberger and F. T. Rubidge.

American Electrochemical Society will hold its spring meeting in Baltimore, Md., April 27-29. Preparations are being made for three sessions, in connection with this meeting, as follows: Electric furnace cast iron; gases of the electrochemical industries, and electromotive chemistry.

OBITUARY

Leonard Whitney, assistant superintendent of the Katherine mine, at Katherine, Mohave County, Ariz., was killed by the bursting of an 18,000 lb. flywheel of a new hoisting installation which had just been put in operation. Mr. Whitney was a former officer of the 331st Infantry, from Illinois.

John Ross, mining engineer of more than 30 years' experience on the Mother lode of Nevada, died on Dec. 25 in Sparks, Nev. Mr. Ross was active for years in the development of the Keystone and Mahoney mines, and was also one of the principal developers of the famous Unionville properties.

Charles F. Jennings, for 14 years purchasing agent of the Utah Copper Co., died at Salt Lake City, Dec. 27, following an operation. Mr. Jennings was born at Laramie, Wyo., in 1873, and received his education in the public schools and university of that state. He came to Utah in 1897 and became a member of the purchasing department of the Oregon Short Line R.R. in which capacity he remained until 1907, when he joined the staff of the Utah Copper Co.

De Bermiere Whitaker, vice-president and general manager of the Bethlehem Mines Co., a subsidiary of the Bethlehem Steel Co., died on Dec. 25 at Santiago, Cuba. Mr. Whitaker, who was fifty-two years old, was born in Enfield, N. C., the son of the late Judge Spier Whitaker, and was educated at the University of North Carolina. He went to Santiago in 1898 as chemist of the Spanish-American Iron Co., and later became superintendent of the Juragua Iron Co. He was placed in charge of the consolidation of the two concerns when they were merged under Bethlehem control.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Announcement during the week that Anaconda, Butte & Superior and Tuolumne would resume production in the near future was at once the most important and most cheering event in many months. Other companies joined with them in effecting a reduction in wages. Men are reported to be flocking into Butte.

Anaconda in the same week is said to have received its first order for the new copper shingles that it proposes to turn out in quantity.

Stockholders of the Ray-Hercules Copper Co., which controls the Arizona Hercules company against which the Empire Trust Co. recently secured a judgment, have been advised of a plan for reorganizing the company. The old stock will be wiped out, it is said.

A wage reduction of about 50c. per shift has been announced by the Hollinger, Dome and McIntyre companies at Porcupine, Ont.

The trial of the Iron Cap-Arizona Commercial apex suit has ended. The decision, it is expected, will not be handed down for some time.

Three Companies Will Resume Production at Butte

Anaconda To Have Output of 5,000,000 Pounds Copper Monthly by Feb. 15 —All Wages Reduced

It was officially announced in Butte, Mont., on Dec. 29 that the Anaconda Copper Mining Co., the Butte & Superior Mining Co. and the Tuolumne Copper Mining Co. would start work Jan. 16 preparatory to resuming production. Anaconda officials explained on Jan. 2 that four of the company's larger mines would resume Jan. 16 and that by Feb. 15 they hoped to have production under way at the rate of 5,000,000 lb. of copper monthly, or approximately 20 per cent of a normal of 25,000,000 lb.

Butte & Superior, it was said, expected to start shipping zinc concentrates within a few days from its stock pile to Anaconda's electrolytic plant at Great Falls and would start its Black Rock concentrator by Jan. 10 or Jan. 15. The same company also announced that it would gradually increase its working force to 1,000 men.

Anaconda's zinc plant at Great Falls and the arsenic plant at the Washoe reduction works have already resumed. It was said that the Washoe smelter would probably start on a limited scale during the first week of the year.

All companies in the district have joined in an agreement to make a horizontal wage cut in all classes of mine, mill and smelter labor of 50c. per shift, making $4.25 the basic wage for miners. Men are said to be flocking back to Butte but most of them are inexperienced so that in any case it will be some time before production can be resumed at capacity. Mine forces in the Butte district will be increased gradually up to 10,000 men and men are being put on as fast as they apply.

The East Helena plant of the American Smelting & Refining Co. will treat residues from Anaconda's zinc plant under arrangements recently concluded, which will necessitate additional furnace capacity. It is expected that an additional furnace will be started soon.

Porcupine Mining Companies Cut Wages Jan. 1

Hollinger, Dome and McIntyre Announce Decreases Equivalent to 50c. Per Shift

One of the most important events of the Porcupine camp in Ontario during the past year was the recent posting of notices by the Dome, McIntyre and Hollinger companies that commencing Jan. 1 wages would be reduced 6c. an hour, or approximately 50c. per day. This will give drill runners $4.75 per day, which is 25 cents higher than the Cobalt scale. To date only one mine in Kirkland has posted a cut in wages, but in view of the action at the Porcupine mines there is no doubt that a general cut will, very shortly, be put into effect in Kirkland.

The effect of this action will be widespread. Not only will it permit the mining of lower-grade ore in both Kirkland and Porcupine, but it will be a material inducement to go ahead with the opening up of new properties. One of the deterrent factors in the developing of prospects has been the high wages which had to be paid. Taking into consideration the boarding houses, which inevitable show a loss on small operations, the daily cost for miners would run from $5.50 to $6.

Freight Rates on Lead Bullion Lowered

Effects Product Shipped From Tacoma, Kellogg, Northport, and Montana Smelters

New freight rates have been announced on lead bullion and other smelter products from Tacoma, Kellogg, Northport and Montana smelting pionts, effective as from Jan. 5, 1922. The rates have been approved by the Interstate Commerce Commission and are as follows: To Pittsburgh, $13.25; Cleveland, $13.25; Indianapolis, $12.75; Chicago, $12; St. Louis, $11.40; Kansas City and Omaha, $10.80; St. Paul, Minneapolis and Duluth, $9.

Plan To Reorganize Ray Hercules Before Stockholders

Old Stock Wiped Out—New Company To Be Called Ray Hercules Mines, Inc.—Robert Linton in Charge

A plan for reorganizing the Ray Hercules Copper Co. has been put before the company's stockholders. The Empire Trust Co., of New York, recently took judgment by default in its foreclosure suit against the Arizona Hercules Copper Co., controlled by Ray Hercules, the amount being over $3,577,000. The new company will be known as the Ray Hercules Mines, Inc., and will have an authorized capital of $1,000,000 first mortgage 6 per cent bonds and 1,200,000 shares of stock of $5 par value.

Creditors of the present company and those directors who advanced the company money to complete construction and development, aggregating $2,287,562, are to be given $1,000,000 in first mortgage 6 per cent bonds and 250,000 shares of stock in the reorganized company.

It is said to be impossible to avoid wiping out the present stock of Ray Hercules, of which about 1,500,000 shares are outstanding, but the holders will be offered 750,000 shares of new stock of $5 par on cancelation and surrender of their present stock in the ratio of one new share for every two shares now held at $1 per share on or before Jan. 31, 1922.

Proceeds of these 750,000 shares of stock, up to the amount of $500,000, is to be placed in the treasury of the new company for working capital and, after $500,000 has been so provided, not more than $200,000 of such funds is to be applied to the payment of the old company's notes to enable the creditors to liquidate an equal amount of indebtedness guaranteed by them. If sufficient stock for these purposes is not subscribed for, the creditors reserve the right to purchase from the treasury of the new company at $2 per share sufficient of the unsubscribed stock (but

not more than 100,000 shares) to liquidate this indebtedness of $200,000. Any portion of the 750,000 shares not so taken by the stockholders of the old company at $1 per share or by the creditors at $2 per share may be disposed of for corporate purposes at the discretion of the directors of the new company.

The remaining 200,000 shares of the authorized capital of the new company will be held in the treasury for conversion of the bonds at $5 per share.

Robert Linton, president of North Butte, is managing director of the company. Mr. Linton estimates the ore indicated by churn drilling and underground work, in ground wholly or partially developed, to be 3,916,000 tons averaging 2.42 per cent copper. From this has been mined 172,000 tons of ore averaging 2.20 per cent copper, leaving the net available ore 3,744,000 dry tons averaging 2.43 per cent copper.

Spain Gives Up Control of Mines at Almaden

By Cable From Reuters to "Engineering and Mining Journal"

Madrid, Jan. 2—A statement issued by the Ministry of Finance announces that the contract concluded with a London firm for the sale of quicksilver from the Government owned Almaden and Arrayanes mines lapsed on Dec. 31. The board of management of the two mines alone will henceforth control the sale and have full powers to conclude agreements with other centers producing quicksilver at the minimum price for a period not exceeding six months.

Japan Maintains Connections With Siberia

Yokohama, Dec. 10—For the first time in history, communication will be kept up this winter between the main island of Japan and the port of De Castri, on the Siberian mainland, 800 miles north of Vladivostok, and opposite the north end of the island of Sakhalin.

The "Otomaru," a Japanese naval ice-breaker, will be kept in regular service betwen Aomori, Japan, and the ports of Alexandrovsk (Sakhalin), and De Castri. From De Castri, the Japanese will maintain sledge service 100 miles further north to Nikolaievsk, at the mouth of the Amur River.

Nikolaievsk was the seat of the massacre of Japanese subjects in May, 1920, and the maintaining of the winter service will effectually prevent any recurrence of such an event.

Temiskaming Laboratories' Work To Be Continued

The Minister of Mines has announced that operations will be continued at the Temiskaming Testing Laboratories in Cobalt. This plant was taken over by the Government more than a year ago, and is a combined sampling and assay office. It has been of great benefit to the Cobalt companies, as it is the only sampler in Cobalt for high grade ores.

New Diamond Field Opened in British Guiana

Promising Area Opened on Kurupung River—Washers Producing 100 to 200 Carats Per Day—Rush Follows to District

Georgetown, Nov. 16.—Early in October, 1921, news began to filter down to Georgetown, from the interior, of a new area of very promising diamond territory, that had been opened up on the Kurupung, a branch of the Mazaruni River. Largely owing to unemployment on the coast lands, caused by the slump in both the sugar and rice markets, a rush for the new field naturally followed.

NEW DIAMOND REGION OPENED IN BRITISH GUIANA

The latest reports received are that the Kurupung is proving a bonanza and washers are already returning to town with the first stones from the new area. According to these early arrivals, single washers are producing from 100 to 200 carats per day. Men from the adjoining gold and diamond fields, Meamu, Perenong, Eping and Saranamue have abandoned their old claims and rushed to the new district. It is estimated that at least 8,000 men are now working along the Kurupung and the Government has taken steps to police the new camps.

A new record stone, weighing 29⅜ carats, has been found and is now being brought down to Georgetown. The previous record stone was the "Gushway" diamond, weighing 27½ carats, found several years ago, which was noted owing to the amount of litigation which it produced.

Several new buyers have arrived so that there are now eight licensed buyers purchasing stones in Georgetown. It is rather hard to ascertain the prices being paid as dealings are carried on privately between the individual buyer and the washer bringing down the stones. Package stones or "run of mine" have been sold at from $10 to $25 a carat, while selected stones have brought from $40 to $60 per carat, it is said.

The Customs reports give 79,733 carats of diamonds exported this year up to Nov. 10 as against 19,175 exported during the same period of last year.

The diamond fields of the colony are being worked almost entirely by the native black, as the difficulties of access and the health conditions have discouraged organized capital from entering the industry. The transporting of supplies to the new district will undoubtedly be the controlling factor in its development. It takes from two to three weeks to haul boats carrying supplies up the rapids of the Mazaruni to the mouth of the Kurupung and at this slow rate the amount of stores that can be taken in by a boat crew is comparatively small.

Metallurgical School Started at Jamshedpur

Bombay, Dec. 2—The Tata Iron & Steel Co. is opening a metallurgical school at Jamshedpur with the object of training young men to take the place of imported labor at the furnaces.

Anaconda Gets First Order for Copper Shingles

Washoe Foundry Superintendent Describes New Product—Company Now in Market, It Is Announced

BY A. B. KEITH

The Anaconda Copper Mining Co. has recently received its first order for copper shingles and from the number of inquiries being made enthusiasm is running high as to the outlook for this venture of the company. John Gillie, manager of Anaconda's mines, in an address to the board of directors of the Butte Chamber of Commerce, said that if the market for these shingles measured up to what they expected, half of the copper production of the whole country would be utilized in their manufacture. Formal announcement was made that the Anaconda now is in the market and is ready to supply the trade with either copper or zinc shingles.

Harold Blake, superintendent of the foundry department of the Washoe smelters, in the course of an address to the chamber, submitted interesting figures pertaining to this latest product of the Anaconda, stating that the initial cost of copper shingles over wooden was only about twice that for the wooden article, but when it was taken into consideration that the life of the wooden shingle averaged only about ten years while that of the copper was 100 years, or really as long as the foundation of the building endured, the material advantage in favor of the metal shingle was obvious. Again Mr. Blake pointed out that in case of a fire there was no salvage value whatever to a wooden shingle whereas it was 60 per cent for the copper shingle, represented by the value of the metal. In the case of slate, asbestos or tile, the copper shingle had a material advantage in the first cost, he said, and further, the laying of copper shingles required no particular skill and twice the area could be covered in a day than with the wooden shingle. Against this the service of a skilled artisan was required when a roofing of slate, asbestos or tile was to be laid.

This copper shingle, which is of 9-oz. sheeting, makes a roofing weighing only 84 lb. to the square (100 sq.ft.) in place, and is probably the lightest substantial material which may be employed for roofing purposes. This weight compares with 600 lb. for Johns-Manville Color-Blende asbestos; 75 to 1,000 lb. for slate and 1,200 to 2,000 lb. for tile. In the matter of roof trussing the lesser weight of the copper will make for considerable economy in construction costs. The copper shingle is not applicable to flat roofs, he said, but to meet this need the Anaconda is producing a copper sheet with a tinned edge to permit of soldering. The duplicate of the copper shingle is being manufactured in zinc, the initial cost of which is only 15 per cent over the wooden shingle, and when the latter has been painted or stained, this margin is further reduced. The company also plans to make sidings for bungalows, buildings, warehouses and in fact, for any sort of construction, with the same argument as to durability applying as pertains to the metal roofing, expedition in building and a reduction of the fire hazard.

Through a process of oxidation the company's metallurgists have achieved some very skillful results, enabling the fixing of a color ranging from a very dark green to a brownish red, with the added quality that this variation of hues can be varnished by scrubbing the metal with a solution of salammoniac, which will leave the sheeting the beautiful green color so characteristic of copper roofs observed near the sea coast.

The new shingles are 18-in. long by 6 in. wide and will be laid the long way horizontally. The 9-oz. material is recommended by the Anaconda for copper roofing, and with the shingles come copper nails and such roofing auxiliaries as flashings, valleys, hips, verges and spouts, as desired. Copper roofing should cost around $22 per square f.o.b. Anaconda, Mont., for the 9-oz. sheets. The shingle is known as "'Anaconda Roofing" and is 99.95 per cent copper.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Placing of Duty on Pyrites Strongly Opposed

Thought That Sulphur Producers Would Profit—No Protection Needed by These, It Is Said

Apparently the Finance committee of the Senate has been convinced that iron pyrites should stay on the free list. There is powerful opposition to any duty on this basic chemical raw material. The best point made by the opponents of a pyrites duty was a quotation from a report by the United States Tariff Commission to the effect that the serious competition which domestic pyrites producers face comes from American sulphur rather than from imported pyrites. It was pointed out to the committee that American sulphur has made such inroads on the use of pyrites that less than one-fourth the prewar tonnage now is imported. The price of sulphur has declined to the point where foreign pyrites can no longer compete with it, it was argued, except at points highly favored in the matter of transportation, such as Atlantic ports. A tariff on pyrites, the Senate committee was told, would have the effect of prohibiting further importations, but sulphur and not domestic pyrites would be substituted unless sulphur producers should advance their prices greatly. The point was made that a tariff on pyrites would be a standing invitation to domestic sulphur producers to add the amount of the duty to the price of their product. Evidence that the domestic sulphur industry does not need protection was laid before the committee in the form of an official report showing that American sulphur has displaced the Sicilian product in the important Scandinavian markets and is being sold extensively in England, France and Germany.

Tariff on Asbestos Sought

The Association of Asbestos Mines of Arizona has submitted a brief to the Senate Finance Committee asking that a flat duty of 20c. per lb. be placed on all asbestos ore and fiber. The belief is expressed that the better grades of Arizona fiber which go into the yarns upon which the manufacturers receive a protection of $1.68 per lb., cost at least 30c. per lb. more to prepare and produce than does the fiber produced by Kaffir labor, while the so-called Arizona No. 2 fiber costs at least 20c. per lb. more to deliver.

Over Half of Railroad Tonnage Mine Products

Class 1 Roads in Third Quarter Carried Over Quarter Billion Tons —140,000,000 From Mines

Considerably more than half of the freight tonnage handled by the railroads of the country during the third quarter of 1921 was made up of commodities classed as "products of mines." The total amount of revenue freight handled during that period by the class 1 railroads, which handle 99 per cent of the traffic was 252,456,817 tons. The commodities produced at mines furnished revenue freight to the amount of 139,947,089 tons. The detailed figures, which are those of the Interstate Commerce Commission, show an increase over the second quarter of more than 15,000,000 tons of mine products moved.

The tonnage of mine products originating on railroads in the eastern district during the third quarter was 71,940,328 tons; in the Pocahontas region, 12,618,966 tons; in the southern district, 15,434,360 tons; in the western district, 39,953,435 tons. A significant feature of the figures is that the iron ore movement in the western district totalled 13,619,045 tons.

NEWS BY MINING DISTRICTS

London Letter

Mozambique Company Reports—Russo-Asiatic Consolidated's Property in France — Geduld Proprietary Increases Reserves

BY W. A. DOMAN

London, Dec. 20—According to the annual report of the Mozambique Company for the calendar year 1920, mining in the territory did not make much headway. The value of the gold produced was £40,031, and of the silver, £103, a total of £40,134, as compared with £20,610 in gold, and £57 in silver, in 1919, or £20,667 in all. From one standpoint this is satisfactory, but fewer mines were working, and only thirty-eight prospecting licenses were issued as against 222 in 1919. The Edmundian copper mine produced 132 tons of copper valued at £15,500, and the tin output was about 21 tons, of an estimated value of £4,555.

The Russo-Asiatic corporation appears to be making good progress with its base metal property in the south of Franch. According to a circular just issued, the Villemagne Concession lies in the departments of the Gard and Lozere, a highly mineralized district containing, among others, the well-known lead and silver mines of Malines, which have a long record of dividends and are still in operation. There is a strong east and west lode on the Villemagne Concession, outcropping at intervals for several miles, and there is a plentiful showing of zinc blende. Under the former French company, which worked with rather primitive methods, nearly 5,000 tons of concentrates was produced in 1913 and 1914, averaging 55 per cent lead, and 20 oz. silver per ton. According to the records of the French company, there were 500,000 tons of ore developed in the mine, containing, so far as can be ascertained, from 6 to 8 per cent lead, and 3 to 4 oz. silver; certain portions are high in zinc, running from 15 to 30 per cent. A geological survey of the concession has been made, and over a length of 4,000 ft. seven bore holes have been sunk, all of them uncovering ore, from 7 to 20 ft. wide, and assaying 8 per cent lead, 10 per cent zinc, and 5 to 6 oz. silver. New horizontal orebodies have been discovered, replacing some of the sedimentary bodies, and giving very substantial assays in all three metals. It is estimated that with lead at £22 per ton, zinc at £26, and silver at 3s. per oz., a milling mixture would yield a profit of £2 per ton. Already 1,000,000 tons of ore have been proved, and further boring is expected to prove the existence of several millions more.

The El Oro Mining & Railway Co. announced at a meeting a few days ago that through its investment company it had secured a twenty-five year lease on a silver mine belonging to the Noria Development Co., in the state of Zacatecas, and upon an adjoining mining area upon terms giving the investment company an interest of 60 per cent, and, in certain eventualities, 72 per cent of all profits derived from its operation. The Noria is described as a developed mine.

The Mexican Corporation is making an issue of £380,000, 10 per cent seven-year convertible notes, repayable at 120 per cent. The money is largely required for working the Fresnillo mine. The milling capacity is to be increased to 75,000 tons monthly, and the profits are to be divided thus: 20 per cent to be retained by the Mexican Corporation until the excess expenditure (up to $800,000) in constructing the plant over the original estimate has been amortized, the remaining profit to be divided equally between Mexican Corporation and the Fresnillo company until a sum of $5,000,000, including the $800,000, has been received by the Mexican Corporation. According to the corporation's engineers, the Quarry orebody contains a minimum of 4,000,000 tons of ore in sight, with good possibilities of extension.

A cablegram just to hand from Johannesburg states that in the Geduld Proprietary mine the reef has been cut in No. 6 level crosscut from Shaft No. 7, the value being 2 oz. over 28 in., with the reef not yet fully exposed. This development is in the rich area of the property which has been opened up hitherto on No. 7 level, as No. 6 level had not been started. The importance of the cablegram lies in the fact that the high-grade ore met with on No. 7 level extends up to No. 6, and consequently adds greatly to the value of the mine.

Those interested in the tin-winning industry are beginning to hold up their heads again, for the price of the metal has recovered to over £171. That figure is not sufficient to make it possible for work generally to be conducted at a profit, but it gives promise of improvement, and the share market is rallying. Stocks in the East are gradually undergoing reduction, though fresh supplies are being created.

The Malayan Tin Dredging Co. ran four dredges in the twelve months to June 30, a total of 24,927 hours, dredging 3,258,200 cu.yd., 46.32 acres, as compared with 2,558,500 cu.yd. in the the preceding year. The average value of the ground was .48 *katis*, in contrast with .39 *katis*, the result being an output of 939 tons against 594 tons.

[The *kati* is a Chinese weight equal to one and one-third pounds.]

Johannesburg Letter

An Executive's View of the Labor Situation—Strike at Crown Mines Spreads — Mining Regulations Changed—Diamond Companies Retrenching — Zululand Coast Surveyed

BY JOHN WATSON

Johannesburg, Nov. 29—The annual meeting of the Johannesburg Consolidated Investment Co., (the parent company of the house of Barnato) was held on Nov. 23 in Johannesburg, Prof. J. G. Lawn, joint managing director, presiding. In the course of an address, referring to the gold premium, he said the average price at the beginning of July, 1920, had been £5 4s. per fine oz.; the price rose steadily to £6 1s. 4 d. in November and again fell to £5 2s. 8d. in May.

The efficiency of white labor had been reduced by a shortening of the hours of work and the granting of regular holidays, amounting to four weeks per year for underground workers. This was just, according to Prof. Lawn, but it must not be forgotten that the industry has paid and is paying for such concessions. Unfortunately, there was no reciprocal keenness or loyal service on the part of the workers, he said. The constant and unending agitation and hunt for grievances, the constant harassing of the mine managers and other officials, the frequent sectional strikes, were all evidences of the position. There was great talk of co-operation and mutual bargaining; but it had mostly been one-sided. It had been a case of concession after concession on the part of the mines until the position had become well-nigh impossible and only sustained at all by virtue of the gold premium. There were more white workers employed in the industry than were necessary, which added greatly to working costs. These surplus workers were thrust upon the industry by government regulations, and by agitation and threats on the part of the European employees. It would be much cheaper, said Prof. Lawn, for the industry to support these surplus white men in idleness at the coast than to keep them at the mines.

A strike which started at the Crown Mines on Nov. 10 over the dismissal of a shift boss who was a member of the Mine Workers' Union has grown in dimensions. The union appealed to the Chamber of Mines for a board of reference. An inquiry held by two government inspectors disclosed the cause of the dismissal, upholding the company. All the miners at the property came out Nov. 25. The general manager, A. J. Walton, replied by giving notice to all men on strike that they were dis-

charged from the company's service as from Nov. 25. On Nov. 29, 461 other European workers were unable to work and the management had been compelled to give them notice. The Minister of Mines, F. S. Malan, has been in Johannesburg, trying to patch up a peace, so far without success.

The sub-committee on the amendment of the mining regulations sat at the New Law Courts, Johannesburg, on Nov. 15, when the Prime Minister, General Smuts, again presided. Certain new regulations drafted by the government mining engineer, Sir Robert Kotzé, were discussed and after slight alterations were agreed to by the Mine Workers' representatives, also by the Chamber of Mines. The effect of these alterations will be to allow each working place, before the commencement of a shift, to be examined by a competent miner, who shall make it safe to work in. The effect of this and other changes will be that the white miner and his "boys" will get a better start each morning and thus increase the efficiency of the native underground worker.

The output of diamonds in the Union fell from 2,156,900 carats in 1913 to 905,300 in 1920. The value per carat increased up to 1920 when there was a fall. The De Beers company during the last year or so, has spent over £1,000,000 in maintaining 1,000 employees on non-productive work. Now, their funds are reduced to the danger point and the board will be compelled to retrench, remembering as far as possible the claims of their old employees. Further retrenchment is also taking place at Jagersfontein diamond mine in the Free State, where it is said working expenses are to be curtailed by one-third; this will probably mean a reduction of of wages of several whites and the discharge of a number of natives.

A survey was recently made of the Zululand coast near Kosi Bay by government representatives. Another party has also been surveying on land. In recent years, several large collieries have started operations in the Vryheid district. A railway line from Kosi Lake in a southwesterly direction along the watershed between the Umkusi and Ponzola rivers would reach the railhead of the existing line to Vryheid within a distance of 120 miles. The mouth of the Kosi River is in British territory in the northern part of Zululand, known as Amatongaland and is only about 70 miles (as the crow flies) south of Lourenço Marques (Delagoa Bay) the latter being in Portuguese East Africa.

COLOMBIA

The British Platinum & Gold Corporation began operations with its first dredge on Dec. 1, 1920. To July 31, the end of the company's year, 177,000 cu.yd. was dredged, for a gross value of platinum and gold of £26,723, the average per cu.yd. being 36.32d. and the field cost 9.97d. Platinum ranged from £17 to £20 10s. per Troy ounce, and contributed £25,177 to the total.

CANADA

British Columbia

Premier's Tramway To Be Running Soon—Bunkers Described

Stewart—The aerial tramway to the Premier mine has been completed and will soon be in operation. There is still some work to be done on the bunkers at the dock. The tramway is 11½ miles long, contains 46 miles of cable on which there are 125 7-cu.ft. buckets. The traveling speed is six miles an hour. Ten tons of ore per hour can be handled over the line. Three telephone lines have been strung along the route, two for operation purposes and the other for the use of the company. Three men will be employed walking over the line continuously. The power necessary will be generated at the mine.

The bunker has a capacity of 1,500 tons. The bunker itself is about the center of a three-story building, 210 ft. long by 36 ft. wide, and containing about 400,000 ft. of lumber. The top floor is taken up by the tram terminal which runs into it a distance of 150 ft. Trap doors have been let into the floor, through which the ore will be dumped from the buckets to the bunker. On this floor ahead of the terminal rails is a large space to be used for incoming freight and in front of this again there are two sleeping rooms and a large office. An inclined elevator will be operated by a 10-hp. Fairbanks-Morse gasoline engine which is also installed on this floor. The elevator is so constructed as to permit the delivery of freight from the dock to each of the floors of the building. The second floor is confined to the bunker itself and makes provision also for considerable warehouse space. The first, or ground floor, is devoted to the conveyor belt, on either side of which is space for the storing of 1,000 tons of concentrates. A 20-hp. Fairbanks-Morse gasoline engine operates the conveyor belt, which runs the full length of the building from behind the bunkers. The transfer of ore across the dock is provided for by another belt which lifts when not in use. A Delco plant has been installed for lighting purposes, capable of carrying at least 100 average-size lamps. The work has been done by Riblet Brothers, of Spokane, under the superintendence of L. H. Graham.

Alice Arm—A lower tunnel is being driven on the Esperanza property. Already it is in 110 ft. and ore is expected to be cut at 135 ft. Work is being continued during the winter.

The residents of Alice Arm are signing a petition to the Government asking that other companies be permitted to operate the Alice Arm-Dolly Varden railway next year in the event of its being left inactive by the Taylor Engineering Co. The explanation is that lack of transportation this year has seriously handicapped the development work on many properties of the upper Kitsault Valley.

Vancouver—The charges laid against E. J. Donoghue and C. P. Browning, of the Britannia Mining and Smelting Co., of criminal negligence in connection with the catastrophe that recently destroyed the mining community of Britannia Beach with much loss of life, have been dismissed. The magistrate observed that the Crown had not presented evidence to show who was in control at the time of the disaster and there was nothing to indicate that anyone had thought there was danger. The water only once before had come to the top of the culvert, the washing away of which was alleged to have caused the flood. There did not seem to have been any lack of precaution. The company had exercised its best judgment and the only thing that could be charged was an error of judgment.

Ontario

Pending Bill To License Engineers Arouses Interest—Trethewey Silver Stockholders Asked To Ratify Reorganization Plan

Toronto—A great deal of interest is being shown over the proposed professional Engineers' bill, which will be presented before the Ontario Legislature at the next session of the House, early in 1922. The bill is somewhat similar in nature to that which is already in effect in several of the provinces of Canada and in a number of the states in the United States, and it seems to be received by considerable favor from the civil, mechanical and electrical branches. Considerable opposition has, however, arisen from the mining fraternity, and it is very doubtful if the mining engineers will endorse it. The mining engineers do not wish any legislation brought in which will interfere with the development of the mineral resources, or which will, in any way, lead to keeping out engineers from any country or other province. Another factor which the mining engineers take into consideration is that the average mining engineer, in addition to the purely mining side of his profession, usually has to undertake work which is ordinarily considered to belong to the civil and mechanical branches. As registration for the different branches would be in the hands of engineers appointed from these particular classes, the mining engineers feel that there might be some difficulty in their obtaining registration in all the branches, to which they feel they are entitled.

Cobalt—It is understood that the year's production of the Mining Corporation of Canada will be approximately $1,300,000. Additional machinery is being sent to the Haileybury Frontier in South Lorraine, which the company has under option. It is understood that development work to date has been very satisfactory.

A meeting of the shareholders of the Trethewey Silver Mines will be called in January to ratify the directors' reorganization proposal. The capitalization is 2,000,000 shares of $1 par, of which 1,600,000 have been issued. The

new company will have the same capitalization, and will issue one share of the new stock for four shares of the old. This will mean an issued capital of 400,000 shares, with 1,600,000 shares in the treasury. The treasury stock will be offered to shareholders at 10c. per share and the money raised will be utilized to pay off the obligations of the company and build a small mill, without which it is impossible to continue profitable operations. The company owes about $40,000.

It is understood that the Lorraine Consolidated may be re-opened in the near future.

There were no ore shipments from Cobalt reported for the week ended Dec. 23.

Kirkland Lake—Notice has been given by the Minister of Mines that under Section 39 of the Mines Act all islands in Sesekinika Lake, in the Townships of Grenville and Maisonville have been withdrawn from staking or leasing, except all valid claims now existing.

It is understood that announcement will very shortly be made to the effect that the troubles arising from the power shortage in Porcupine have been solved, and that the camp will be guaranteed an adequate supply of hydro-electric energy. The full effect of this will not be apparent until 1923, but it will permit the mines to go ahead with the policy of expansion, which has been held up on account of the shortage of power.

It is reported that a rich surface discovery has been made on the property of the Lightning River Gold Mines, near Lake Abitibi.

Porcupine—On account of the power shortage, the Davidson has been forced to suspend underground operations, but it is understood that some diamond drilling will be done.

The seventh hole has been drilled on the Rochester property, which is under option to the Nipissing. It is understood that results to date have not been encouraging.

Satisfactory results are said to have been obtained by the Gold Islet and Peninsula properties on Night Hawk Lake, near Porcupine. On the former property 2,800 ft. of diamond drilling was done and a shaft sunk 100 ft. On the Peninsula drifts have been run on the ore at 100 and 200 ft. levels.

Underground operations have been resumed by the Hayden property.

Shareholders of the Vipond-North Thompson have ratified the proposal to sell 475,000 shares of treasury stock at 15c. a share to a syndicate headed by H. B. Wills.

An electric mining plant has been ordered for the Porter Gold Mines, near Goudreau, in the Soo district. Power will be secured from the transmission lines of the old Magpie iron mine, about six miles distant. Two shafts are being sunk by hand, one of which is down about 20 ft., and very high assays are being reported.

Nipissing is investigating a gold prospect in the vicinity of Sault Ste. Marie.

ARIZONA

Mining Company Objects To Flood-Control Dam—Awaiting Decision in Iron Cap Suit—Judgment Given Against Schuylkill

BY JAMES H. MCCLINTOCK

Phoenix—The state, county, city and others interested in construction of the Cave Creek flood-control dam have been warned by the Amalgamated Copper Mines Co., through its attorney, Joseph F. Morrison, against entry on the ground of the corporation, this with allegation of probable damage to a group of mining claims, said to be of value. Construction of the dam is to be pushed, with filing of a damage bond, if necessary, as the structure is declared essential to insure the safety of the western part of Phoenix, inclusive of the capitol.

Three court reporters are working on the 500,000-word transcript of the Iron Cap-Arizona Commercial trial at Globe, the result to be submitted to the presiding magistrate, Judge Sam Pattee, of Tucson. Herman E. Zulch, of Oatman, is copying the engineering exhibits, of which thirty-one were submitted by the Iron Cap and fifty-two by the Arizona Commercial, mainly comprising drawings of the geological strata and orebodies considered. The suit took eight days. No early decision is expected, in view of the mass of technical testimony of conflicting character.

In the Superior Court of Cochise County Harry F. Scott has been given judgment against the Dragoon Mountain Copper Co., earlier known as the Mining & Development Corporation of Arizona, a promotion of Martin Fishback of Benson. The award, of less than $1,000, is one of a number taken against the same property.

At Kingman, Frank A. Garbutt has secured judgment and order of sale against the Schuylkill Mining Co. for $342,400 and costs, the principal sum stated to have been advanced by the plaintiff to pay for the property and to advance its development. This was during a period when Ralph Cole was seeking to finance the corporation and during which he made several payments on the purchase price. The property affected, in the Chloride section, includes the Tennessee, Great Lead, Tennessee South, and Black Rock Springs lode claims and the mining and other property known as the Schuylkill mill-site. The property is recognized as one of the largest lead-silver mines of the Southwest, opened to 1,400-ft. depth, with a railroad to the dumps and with fine surface equipment.

Miami—Inspiration is gradually increasing its operating force and is maintaining two underground ore trains, clearing the stopes and raises of ore that is being stored against the time of production.

Bisbee—Hoval A. Smith has returned from a trip to Europe, where he went to interest capital in the Mexican Chispas mine. He is accompanied by an English mining engineer, who will inspect the property.

CALIFORNIA

Idaho-Maryland Said To Have Recovered Eureka Lode—Engels Company President Seeking Proxies from Stockholders

By Our Special Correspondent

San Francisco—The close of 1921 brings with it little of new interest in the mining field. Conditions are slowly improving with increasing interest in gold mining although this interest appears to be confined to smaller and desultory operations. Recently a new gold dredge built by the LaGrange Gold Dredging Co. was launched at LaGrange preliminary to undertaking dredging operations on the Tuolumne River.

Local reports from Grass Valley credit the management of the Idaho-Maryland with the announcement of the recovery of the Eureka lode in the bottom of the Dorsey winze. Another discovery upon the lowest level of the mine, said to be an excellent pay shoot, was also announced. Since the unwatering and reopening of the Idaho-Maryland by the Bulkeley Wells interests, a conservative campaign of prospecting and development has been under way. It is expected that this will result in milling some time in 1922.

From the Masonic district in Mono County encouraging activity is reported and hopes of mine and claim owners run high.

That discoveries are still possible in the Grass Valley district is indicated by the prospecting of a new ledge which was formed in a grain field near Newton by Arthur Maule. Returns from a small ore shipment were stated to be satisfactory.

The gold production of California is expected to be approximately $16,000,000 for 1921, a gain over the figures of 1920. Silver production will exceed $2,000,000 in value. Copper is expected to reach 12,000,000 lb., the product for the most part of the Engels copper mine.

An interesting situation has arisen in the Engels company. Henry Engels, president of the Engels Copper Mining Company, is seeking proxies from the stockholders of the company. In his letter the statement is made that the company has been badly managed; that it has entered into ill-advised contracts with the railroad and with the power company; that copper had been produced during a period of low prices when it would have saved the company money to have closed down. Against these charges the existing management appears quite capable of presenting an adequate defense, as many improvements in operating conditions have been made and the mine has been extensively developed. From diffused and scattered units, consolidation of plant has been effected and working costs reduced so that operations during the period when most other copper mines were shut down became possible. It is a matter of regret that differences between minority and majority interests have arisen.

NEVADA

"Big Ship" Burned at Tonopah—Tonopah Divide Sinking Below 1,200

Tonopah—Production for the district during the first fifteen days of December as shown by bullion shipments, was as follows: Tonopah Belmont $130,000, West End $59,000, Tonopah Mining Co. $57,000, Tonopah Extension $49,500. Practically all of the mines in the Tonopah district closed down for two days at Christmas, and on Dec. 25 $5 Christmas checks were distributed to employees.

On the night of Dec. 23 the "Big Ship," probably the best known miners' boarding and rooming house in Nevada and which was purchased by the Tonopah Belmont about six weeks ago, was totally destroyed by fire. Three miners lost their lives and thirteen were injured. The spread of the fire was so rapid that those having inside rooms found it difficult to escape. The "Big Ship," until its purchase by the Belmont company, had always been known as the home of the radical element in this district. It is thought that its destruction was due to work of incendiaries and a rigid investigation is now being made.

Divide—At the Tonopah Divide mine the 1,200 level stations have been completed and shaft sinking below the 1,200 level was resumed on Dec. 23. Development work was accomplished on the 2d, 3d, 8th, 10th and 12th levels with no changes reported.

Royston—The west crosscut from the bottom of the Betts shaft has picked up the continuation of the vein at only 20 ft. from the shaft. As noted last week, the shaft passed into the footwall at 42 ft. and was continued to depth of 53 ft. and a crosscut started to the west.

Carson City — Congressman S. S. Arentz and other Western Congressmen are reported to be trying to secure a modification of the regulations of the Pittman Act in order to permit Nevada silver producers and others to send their silver to the Carson City Government Assay Office. The purpose of the modification asked for is to reduce the delay for settlements which it is claimed work a hardship upon small producers. Senator Key Pittman of Nevada is also reported to be seeking a revision of the Leasing law to the extend of authorizing the Secretary of the Interior to grant extensions of time within which prospecting must begin from six months, the time now required, to two years at his discretion.

Judging by increase in premiums paid to the Nevada Industrial Insurance Commission industrial conditions throughout the state are improving. Virginia City, Tonopah and many smaller districts show some noticeable gains.

Virginia City—The Boericke option on the Middle mines of the Comstock lode has been relinquished. Extensive sampling and some development work was accomplished under the direction of Albert Burch.

UTAH

Lessee Cuts New Ore in Iron Blossom —Park City and Tintic Shipments —The Utah Apex Decision

Eureka — Shipments for the week ended Dec. 24 amounted to 141 cars. Shippers were: Tintic Standard, 42 cars; Chief Consolidated, 38; Colorado, 12; Iron Blossom, 11; Victoria, 11; Eagle & Blue Bell, 8; Swansea, 4; Empire Mines, 4; Dragon, 3; Gemini, 2; Sunbeam, 2; Gold Chain, 1; Centennial Eureka, 1; Mammoth, 1; Yankee, 1.

A strike of interest is reported in the Iron Blossom, where a lessee has opened new silver-lead ore which appears promising, although not yet sufficiently opened to permit of definite statement. A dividend of $25,000 was recently paid.

Park City—Shipments for the week ended Dec. 24 amounted to 2,602 tons. Shippers were: Judge allied companies, 1,452 tons; Silver King Coalition, 662; Ontario, 448.

Salt Lake City—The U. S. District Court, on Dec. 16, 1921, awarded the Utah-Apex Mining Co. the sum of $1,154,928.98 as a result of the apex litigation between this company, which operates at Bingham Canyon, Utah, and the Utah Consolidated Mining Co., its neighbor. It will be remembered that Utah-Apex was awarded the decision. The Utah Consolidated was granted a stay of execution for thirty days to give that corporation time to secure a bond.

The litigation between the Utah-Apex and Utah Consolidated mining companies consists of six suits, brought in the U. S. District Court. By mutual consent of the litigants, as the same fundamental question was involved in each, it was decided to try two suits which should govern all six. Five of the cases were decided by the court in favor of the Utah-Apex; and in the remaining case the Court decided that the Utah-Apex had not proved its contentions. The Utah-Consolidated appealed one suit (the Yampa) which covered four suits; and the U. S. Circuit Court of Appeals confirmed the decisions of the trial court in favor of the Utah-Apex, handing down the decision on Nov. 14, 1921. The other two cases have not yet been appealed.

MONTANA

Butte & Superior's Copper Ore on 2,200 Level Improves — Boston & Montana Mill To Increase Tonnage to 500 Daily

Butte—Butte & Superior's copper showing on the 2,200 level has continued to improve and a substantial body of copper ore, about evenly divided as to first and second class, has been proved after 300 ft. of drifting, with the first-class running about 8 per cent copper and more than 12 oz. of silver. A crosscut of the orebody showed 15 ft. wide with the values as stated.

Elkhorn—Boston & Montana concentrator, which is handling 200 tons daily now, will increase its operations at once to 500 tons.

COLORADO

Service on South Park Branch Must Be Continued

Denver—Application of the Colorado & Southern Railway Co. to discontinue daily service on the South Park branch and substitute a tri-weekly service between Leadville and Denver was denied by the Colorado Public Utilities Commission, Dec. 29. The road serves mining districts in Summit, Park and Lake counties. The railroad company based its application upon the contention that the South Park branch was being operated at a loss. The Commission held that since the Colorado & Southern system as a whole was making money, the fact that one of its branches was operating at a loss did not warrant the curtailment of service asked for.

Wolcott—What may devlop into a mining boom of considerable magnitude seems well under way, and is the result of recent strikes made in this vicinity during the fall and winter. A large number of new locations are being made and much development work is in progress. Several old properties which have been idle many years are being reopened. The values are principally in gold and silver.

Silver Plume—On the evening of Dec. 26, the Burleigh mill, owned by the Silver Plume Mines Co., was completely destroyed by fire, the origin of which is supposed to have been defective wiring. The mill was temporarily shut down for repairs and was to have resumed operation Dec. 27. The plant was located on the Dives-Pelican properties and was successfully handling about 100 tons daily from the Pelican dumps, employing flotation and table concentration.

MICHIGAN

The Copper Country

C. & H. Metal Stocks Expected To Be Depleted by May 1

BY M. W. YOUNGS

Houghton—It would appear at this time that the Calumet & Hecla and subsidiary mines will reopen either May 1 or June 1, although this is mere speculation inasmuch as no definite time for resumption has yet been set. The dates mentioned are based on the amount of metal still on hand, and May 1 should see these stocks all but depleted.

The copper companies of the Lake district can mine, smelt and deliver metal in the East in two weeks' time, whereas it requires ninety days for the mines of the Western and Southwestern fields to produce, treat and lay down their copper in New York or other Eastern points.

Of the Calumet & Hecla group, the amygdaloid mines are for the most part in good condition. There has been little or no crushing in the majority of shafts and no great amount of ground has fallen, making resumption possible with little or no shaft repairs or timbering. At Ahmeek No. 2 shaft it has been necessary to take out the concrete skipway and replace it with tim-

ber. Kearsarge No. 1 shaft has been repaired practically to the bottom.

In the conglomerate shafts, where the ground has a greater tendency to crush, it will be necessary to do considerable work. Repairs will be extensive so it is likely this work will be started fully two months before production is resumed. Not a very large force of men will be required, however, to put the shafts in shape.

Arcadian Consolidated is making good progress in sinking its New Baltic shaft from the 9th to the 10th level, from which point a drift will be started to the south to parallel the drift from the 9th level. The shaft is again in the vein and the rock from it is richly shot with copper. The quality of the rock bears out the theory that the shaft is going through a copper shoot, and the continuing values with depth are encouraging. This copper shoot has been encountered on either side of the shaft.

The Cass Copper Co., owning 2,140 acres of land in Ontonagon County, has called for an assessment of 10c. per share on the 54,660 shares of outstanding stock of the company, for the purpose of meeting taxes. The company's land was explored in 1916 and 1918, conditions forcing a suspension of operations. The assessment is payable Jan. 16, 1922.

MINNESOTA

Mesabi Range

Corsica Mine To Be Reopened—Stripping Work Stopped at Boeing Pit

Gilbert—The Pickands & Mather Co. has issued orders for the reopening of the Corsica mine, which will employ approximately 150 men. The reopening is not essential from the standpoint of desiring the ore, but to assist the unemployment situation.

Hibbing—Stripping at the Boeing open pit, a property of the Mesabi Cliffs Iron Mining Co., has been suspended for the winter by the Winston Dear Co. who have the contract. During 1921, 2,400,000 cu.yd. was removed, making a total of 3,700,000 removed. The operating company plans to ship ore from this pit next season.

It has been unofficially announced that the Leetonia and South Agnew mines properties of the Interstate Iron Co., will resume operations soon. Both are underground properties. This will mean the employment of approximately 250 men.

JOPLIN-MIAMI DISTRICT

Skelton Concentrator at Tar River Burned—Pitzer Mine Sold

BY P. R. COLDREN

Joplin—Fire completely destroyed the concentrator of the No. 2 mine of the Skelton Lead & Zinc Co., Tar River, Okla., on the night of Dec. 26. The mill had been inactive for almost a year and the origin of the fire is unknown, but it was reported by the night watchman to have started in the derrick at the mill's shaft. The mill was of 25,000 tons capacity and was erected about four years ago. It has been a big producer, and by estimate about $2,000,000 worth of ore has been taken from it. The mine was one of six owned by the Skelton company and was the second placed in operation. The loss is estimated at from $50,000 to $60,000 with from $30,000 to $40,000 insurance. The Skelton mines are owned by Oklahoma and Kansas people. Frank Childress of Galena, Kan., is superintendent.

Fred A. Barton and associates, of Chicago, have purchased the Pitzer mine, located on Spring River, about 14 miles west of Joplin, for $10,000 cash. The object in making the purchase, however, was unique in this district. It is the plan of the new owners to mine the land for the crushed rock it contains, and to take the zinc and lead ore obtained as a byproduct. The mine has produced about $45,000 worth of ore in the past, the pay dirt being found as shallow at 18 ft. Sand, gravel and classified rock have come in good demand in this district as a result of much road building.

ALABAMA

Progress Towards Normal Continues—Tennessee Coal, Iron & R.R. Co. To Have 600-Ton Stack—Quenelda Graphite Corporation's Property Sold

BY GEORGE HUNTINGTON CLARK

Birmingham—The closing days of the year were noteworthy as still marking advances toward normal. The usual industrial holiday was observed out of regard for the wishes of employees rather than because of any desire of the iron makers to slow up on production.

Of the four blast furnaces belonging to the Tennessee Coal, Iron & R.R. Co., recently in operation on basic at Ensley, one is now running on foundry iron. Another of its idle stacks, which has been for some time undergoing repairs, is being dried out, and will be ready to go in blast as soon as required.

Plans outlined for the rebuilding of No. 1 Ensley stack of this company, will make it, in about six months' time, the record producer of the district, an output of 600 tons per day being expected. The number of tuyeres is to be reduced and the most up-to-date type of blowing engines and other furnace equipment installed. An output of 600 tons will establish a new district record, and will lead eventually to the scrapping and rebuilding of the smaller and inefficient stacks.

The Hattie furnace of the Sloss-Sheffield Steel & Iron Co. at Sheffield will resume operations at once, stocks having been sufficiently worked down to justify increased iron making, for which there is said to be increasing local demand.

As to the merger of independent steel companies recently announced, it is understood that the appraisals of the properties involved have either been or about to be completed, and that the committees working on the general merger plans, will be ready to report early in January.

Involved in one of the two announced mergers are the properties of the Republic Iron & Steel Co. in Alabama, which include three modern blast furnaces, together with ample reserves of raw material.

Furnace interests have been given to understand that as soon as annual inventories are completed, the placing of pig iron contracts for the coming year may be definitely expected.

The beginning of the work of laying concrete on the Mitchell dam recently means that early in 1923 the district will have available nearly another 120,000 hp. of hydro-electric energy, making a total of 300,000 hp. from the Coosa plants of the Alabama Power Co. The expenditure of $8,000,000 on this project will also relieve the condition of unemployment.

An important announcemnt of the week would seem to be the acquirement by Chicago interests, through their attorney Joseph Weisenbach, of all the assets of the Quenelda Graphite Corporation, consisting of some 1,500 acres of ore land, five large graphite plants, and one finishing plant.

It is understood that purchasers will reorganize the company and resume operations, which, if true, it is earnestly hoped may mean the first steps toward the revival of the graphite industry in Alabama, dormant since the signing of the Armistice.

PENNSYLVANIA

E. & G. Brooke Iron Co. Resumes at Birdsboro Plant

Reading—The E. & G. Brooke Iron Co. put its furnace at Birdsboro in blast on Dec. 27, giving work to 130 men. The company has been idle since spring. Its iron mine at French Creek also resumed.

NEW YORK

New Engineer Licensing Law Passed Last May Now Functioning—Percy Barbour Vice-President of State Board

The new engineer licensing law of New York State, which became effective on May 5, 1921, has begun to function. At a session recently held at Albany by the Board of Engineer Examiners, appointed under the law, the first list applicants, numbering 241, was considered and 171 were passed.

Under the law everyone practicing electrical, mining, mechanical, chemical or civil engineering in New York State must now be licensed.

The State Board of Engineer Examiners is composed as follows: President, Albert H. Hooker, chemical engineer, of Niagara Falls; vice-president, Percy E. Barbour, mining engineer, of New York City; secretary, Henry G. Reist, electrical engineering of Schenectady; and Virgil M. Palmer, mechanical engineering, of Rochester; and Col. Walter G. Eliot, civil engineering, of New York.

The Situation at the Mines in December

SENTIMENT continued to improve in December in most districts, though actual operations showed little change from November. The active districts of importance held their own and in some cases increased shipments. Basic conditions affecting mining, such as those of prices, freight and smelting rates, and wage scales, were for the most part unchanged. The outstanding events and those upon which the improvement in sentiment was chiefly founded were the proposal by Anaconda to acquire control of American Brass, which was quickly followed by the announcement that Anaconda and some of the other Butte companies early in January would resume work leading eventually to production; the news that the Colorado Fuel & Iron Co. was to expand its operations beginning Jan. 1; the resumption of work at reduced wages at some Lake Superior iron mines; and the announcement that the Trail smelter would make prompt settlements for custom shipments. Undoubtedly much unemployment existed in some districts. The labor situation in general was favorable to the operator.

Copper companies in Arizona and New Mexico remained inactive except Superior & Boston, which resumed, and Miami and New Cornelia, which produced as usual, the former turning out about 5,500,000 lb. of copper in concentrates and the latter about 1,600,000 lb. of cathode copper, as in November. The International smelter continued to handle Miami concentrates and also treated a small tonnage for Superior & Boston and Inspiration. Ray, Chino, also Utah and Nevada Consolidated remained idle.

On the Coast, gold mining in California proceeded uneventfully. Conditions were fairly normal at Grass Valley. The only copper mining was in Plumas County where the Engels company ran as usual. In Oregon, Washington and British Columbia the situation was quiet, various small operations being under way. In general in the Northwest the outlook for the future was more promising. The Tacoma and Trail smelters ran at about half capacity. A freight reduction of $2 per ton on bullion shipped to Eastern points, effective Jan. 5, was announced.

In northern Idaho the situation was little changed. The output of the Federal, Hecla, and Bunker Hill & Sullivan companies was practically normal and about the same as in November. About 2,000 were employed at the three producing mines and the Bunker Hill smelter and 500 more on the smaller mining and development operations. There were practically no unemployed laborers. The Callahan, Tamarack & Custer and the Hercules were inactive, indications, however, pointing to early resumption by Tamarack and the Hercules.

The situation in Nevada was fairly satisfactory. Heavy storms retarded prospecting and small development operations in remote districts. Tonopah's output was approximately $600,000. Tonopah-Divide's production was unchanged. Developments at Royston and Horn Silver were encouraging. The development and construction work at Virginia City and American Flat progressed.

In Utah, Park City shipped 9,263 tons of ore and concentrates in the first four weeks against 8,330 in November, this being about 1,000 tons above normal. Bingham's output was 15,000 to 16,000 tons of milling lead ore and fluxing iron sulphide ore. Tintic's four weeks' production was 30,352 tons compared with 33,021 in November. Midvale ran three lead furnaces (two in November) and one on matte, Murray three lead furnaces, and Garfield two reverberatories and one blast furnace largely on siliceous silver ores.

Greater confidence in the future was apparent in Colorado. Compared with a year ago the labor situation was greatly improved and the cost of supplies appreciably reduced. The Colorado Fuel & Iron Co. announced that it would increase its operations at the Pueblo steel mills Jan. 1, giving employment there to 2,000 more men. Cresson Consolidated, at Cripple Creek, resumed the declaration of dividends. Numerous operations were under way in various districts. The smelting situation was unimproved.

Conditions continued to better in the Black Hills of South Dakota. The Homestake ran at capacity as in November. The one other large operator, the Trojan, recovered $34,000 in gold from 6,600 tons of ore, as compared to $28,000 from 5,800 tons in November. Activity increased among the smaller operators. The labor situation was unchanged.

Refined copper production fell off somewhat in December in the Michigan Lake district, the output being estimated at 7,500,000 lb. or 33 per cent of normal. Throughout the greater part of the month there were eleven furnaces in blast, against fifteen in November. Calumet & Hecla had seven, Copper Range (Michigan) three, and Quincy one.

Production of zinc ore in the Joplin-Miami district increased slightly, ore prices advancing somewhat. Tonnage produced averaged 7,500 per week, according to estimate, and purchases for the month totaled approximately 32,000 tons. Several mines resumed. Few men were idle. High freight rates continued to hamper work.

Operations in the southeast Missouri lead district continued at about two-thirds of capacity as in November, the general tendency being to increase output slowly. High costs of labor, coal and other supplies served to retard expansion of any kind that the prevailing price of lead might tend to bring about. Wages remained about 30 per cent above the pre-war normal.

In Tennessee, the Ducktown Sulphur, Copper & Iron Co.'s smelter and mill ran at normal capacity. Its production is estimated at about 550,000 lb. of copper. The acid plant remained down. The Tennessee Copper & Chemical Corporation was reported to be running one furnace only and to be making acid at less than half capacity. In the Mascot district, the American Zinc Lead & Smelting Co. operated its mines at about 30 per cent of normal, its output all going to make zinc oxide. In general in the state the situation was unchanged from November.

Operations in the Wisconsin zinc-lead district were practically the same as in November. Production was unchanged, being estimated at 2,500 tons crude blende concentrates, 1,000 tons roasted blende concentrates and 250 tons of lead ore, with no curtailment, the stock of blende concentrates in bins being equivalent to 25,000 tons of roasted ore. Five producers were active during the month, also one roaster, one acid plant, and one oxide plant, and one mill was under construction. One mine, the Big Dick, reopened, the men accepting $2.50 wages.

Signs of improvement in the iron ore business appeared on the Lake Superior ranges. Four mines on the Mesabi Range and three on the Menominee resumed, all with their men on full time and paying the 1913 wage scale. This was probably in part due to a desire to relieve the unemployment situation. At properties working part time no cuts were made. It was said that two of the charcoal iron furnaces in the Lake district would be blown in in January. Iron ore prices for 1922 remained unannounced.

Iron-making conditions in Alabama improved steadily over November. Sloss Sheffield's Hattie furnace was blown in ahead of schedule near the end of the month. Several other idle stacks prepared for resumption. Thirteen were in blast compared with eleven last month and five on July 1. Tennessee Coal, Iron & R.R. Co. operated at two-thirds capacity, an increase of 5 per cent over November. Unemployment was less marked. The Quenelda Graphite Corporation was sold to Chicago interests.

In northern Ontario, dividends declared in December, payable in January, totaled $1,120,000. Cessation of work in the bush caused considerable unemployment but in general the labor situation was good. Production continued normal at Cobalt, increased at Kirkland and receded slightly from above normal to normal at Porcupine. At the last-named camp, there was power enough for McIntyre, Hollinger and Dome but not for Davidson, which shut down. The Silver Cliff, at Cobalt, reopened and the new Ontario Kirkland mill, at Kirkland, was started. In the Sudbury district, Mond Nickel continued its limited production; otherwise things were dead, International Nickel selling $500,000 worth of supplies.

THE MARKET REPORT

Daily Prices of Metals

Dec.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
29	13.625	32.375	32.875	4.70	4.375@4.40	4.80@4.85
30	13.625	32.625	33.125	4.70	4.375@4.40	4.80@4.85
31	13.50@13.625	32.625	33.125	4.70	4.40	4.80@4.85
Jan. 2	.....	.....	.....	....	.....	.....
3	13.50	32.25	32.75	4.70	4.40	4.80@4.85
4	13.50	32.00	32.375	4.70	4.40	4.80@4.85

*These prices correspond to the following quotations for copper delivered: Dec. 29 and 30, 13.875c.; Dec. 31, 13.75@13.875c.; Jan. 3 and 4, 13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations fer zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Dec.	Copper Standard Spot	Copper Standard 3 M	Copper Electrolytic	Tin Spot	Tin 3 M	Lead Spot	Lead 3 M	Zinc Spot	Zinc 3 M
29	66⅛	67⅛	74	170¾	172¾	24⅛	24⅜	27¼	27¼
30	66⅛	67⅛	74	170½	172½	24⅛	24⅛	27⅛	27⅛
31	...	...	...	....	....	...	...	...	...
Jan. 2	....	....	....	.....	.....	...	...	...	...
3	65⅞	66¾	73½	168⅝	170½	24⅜	24¼	27⅜	27⅝
4	65⅝	66⅝	73½	167⅝	169⅝	24¼	24¼	27⅜	27½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Jan.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
29	419	99⅝	65	35⅛	2	....	...	...	...
30	420	99⅝	64¾	34¾	3	420	99⅛	64⅜	34½
31	420¾	99⅝	64⅝	34⅝	4	420	99⅝	65	34⅞

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon.

Cables command one-half cent premium.

Average Metal Prices for December

Copper:	
New York Electrolytic	13.555
London Standard	66.706
London Electrolytic	74.525
Lead:	
New York	4.700
St. Louis	4.369
London	25.322
Silver:	
New York, foreign	65.760
New York, domestic	99.625
London	35.645
Sterling Exchange	414.880
Zinc:	
St. Louis	4.837
London	26.900
Tin:	
99 per cent	32.106
Straits	32.486
London	169.738
Antimony	4.500
Quicksilver	49.212
Platinum	78.192

Metal Markets

New York, Jan. 4, 1922

The holiday dullness in the metal markets has not yet lifted, and business has been exceedingly quiet.

Copper

The larger producers continue to quote 14c., delivered, and up to yesterday were able to sell an occasional carload at that price. Smaller producers and second-hands in general were asking 13.875c. until Saturday, when, in an effort to make sales, prices in several instances were cut to 13.75c. Even offers at this price failed to close a 1,000-ton inquiry from the American Steel & Wire Co., and the business was no doubt placed at a slight concession. Scarcely any copper has been sold at any price, and most of the inquiries were apparently for inventory purposes.

The business of consumers continues good, particularly that of the wire manufacturers, and the lull in demand is caused only by the large sales of the last three months, which have provided for immediate requirements. Sales during this time have almost certainly exceeded deliveries. Consumers who have no large supplies of copper would apparently do well to provide for the future at the present time, for as soon as general buying is resumed, prices are likely to come up to the level of the large producers, who have shown no tendency to weaken. The resumption by Anaconda has without doubt had a slightly depressing effect on the market, despite the fact that production from that source will likely be small for some months. None of the other producers has yet shown any intimation of resuming operations. Meanwhile, stocks are declining rapidly. Even the December sales were much larger than was expected.

Sales for export continue satisfactory, at 14.125c. c.i.f. European ports.

Lead

The American Smelting & Refining Co. continues its official contract price at 4.70c. Business has been quiet at this level. Some producers are asking slightly more, but are getting it only when a special brand of lead is in demand. Corroding grades command from 10 to 15 points' premium. The St. Louis market is slightly stronger. Lead was obtainable up to Saturday for 4.375c., but on that day prices were generally advanced to 4.40c., and, in fact, some business was done as high as 4.45c. Yesterday and today producers were asking 4.40@4.425c., although large lots might possibly still have been obtainable at 4.375c. from one interest.

Zinc

Prices are generally unchanged, and the market has been extremely quiet in the East, with somewhat more activity around Chicago. January deliveries have brought 4.80@4.825c., with the bulk of the metal going at the lower figure. Most of the zinc sold for February delivery has brought 4.85c. The European situation is distinctly encouraging to American producers. German production is less, and that country is unlikely to export any more of the metal for some time. A small export tax, about 4 per cent, has been

levied. Scandinavian stocks of German zinc are about exhausted, and Belgian production has been disappointing. There is a good possibility of American zinc going abroad in the not distant future.

Tin

Tin was in somewhat greater demand on Thursday and Friday, and prices were advanced to over 33c., but the expected rise in London failed to take place. This was possibly owing to the large shipments from the Straits, which were reported for December, although this condition may be reflected in smaller shipments later. Tin for forward delivery has sold for the same prices as for spot.

Arrivals of tin, in long tons: Total for December, 4,090; Jan. 2d, London, 75; Bremen, 25; China, 5; 3d, Straits, 875.

Gold

Gold in London: Dec. 29th, 98s.; 30th, 98s.; Jan. 3d, 97s. 9d.; 4th, 97s. 9d.

Foreign Exchange

The foreign exchange market is virtually unchanged from the quotations ruling last week. On Tuesday, Jan. 2, francs were quoted at 8.0375c.; lire, 4.25c.; and marks, 0.53625c. New York funds in Montreal again sharply declined and were quoted at only 4 1/16 per cent premium.

Silver

The market continued dull, with China and Indian exchanges quoted lower until the 4th, when an advance in the China rates caused buying by China in the London market, with a consequent advance in price there and in New York.

Mexican Dollars—Dec. 29th, 49¼; 30th, 49¼; 31st, 49¼; Jan. 3d, 48½; 4th, 49⅜.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.50c.; market dull. W.C.C. brand, 5¼@5⅜c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7½c. per lb. Market stronger and supplies scanty.

Bismuth—$1.50@$1.55 per lb.

Cadmium—Range $1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2@$2.10 per lb. in bbls.

Iridium—Nominal, $150@$170 per oz.

[1]Molybdenum Metal — In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 35c. Market dead.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—$70 per troy oz. Nominal. $70, Los Angeles, Cal.

Palladium—Nominal, $55@$60 per oz.

Platinum—$80@$84 per oz.

Quicksilver — $51 per 75-lb. flask. San Francisco wires $50. Market active.

[1]Rhodium—$150 per troy oz.

[1]Selenium — Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]Thallium Metal—Ingot, 99 per cent pure, $20 per lb.

[1]Tungsten Metal—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Ore analyzing 40@45 per cent Cr_2O_3, crude, $20@$25 per net ton; ground, $30; analyzing 45@50 per cent Cr_2O_3, $24@$26; ground, $28; f.o.b. Atlantic ports. Quotations are nominal.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore—23@24c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump; $75 per net ton, powdered. Nominal.

Molybdenum Ore—85 per cent MoS_2, 45@50c. per lb. of contained sulphide, New York. Quotation purely nominal.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

[1]Titanium Ores—Ilmenite, 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite or wolframite, 60 per cent WO_3 and over, per unit of WO_3, $2.50, f.o.b. Atlantic ports. Chinese, as low as $2@$2.25.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon—Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

[1]Zirkite—According to conditions, $70 @$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., Dec. 31—Zinc blende per ton, high, $31.80; basis 60 per cent zinc, premium, $29; Prime Western, $28; fines and slimes, $26@$24; average settling price, all grades of zinc, $28.33.

Lead, high, $61.10; basis 90 per cent lead, $58; average settling price, all grades of lead, $58.40 per ton. Rumors of $60 basis lacked verification.

Shipments for the week: Blende, 11,455; lead, 1,877 tons. Value, all ores, for the week, $434,190.

Shipments for the year: Blende, 312,217; calamine, 102; lead, 65,243 tons. Value, all ores, for the year, $11,031,440.

The period of readjustment in 1921 meant a loss to the district, compared with 1920 standards, of $25,000,000. Production decreased by 250,000 tons blende, 10,000 tons calamine and 24,000 tons lead concentrates. Compared with pre-war standards the 1921 valuation is almost $2,000,000 below 1914 and over $4,000,000 under 1913, though the tonnage of blende and lead concentrate in 1921 greatly exceeded either of those years.

Platteville, Wis., Dec. 31—Blende, basis 60 per cent zinc, $30. Lead ore, basis 80 per cent lead, $58 per ton. Shipments for the week: Blende, 186 tons. Shipments for the year: Blende, 11,082; lead ore, 1,793 tons. Shipped during the week to separating plants, 695 tons blende.

Non-Metallic Minerals

Asbestos — Crude No. 1, $1,000@ $1,500; No. 2, $600@$850; spinning fibers, $225@$400; magnesia and compressed sheet fibers, $150@$250; shingle stock, $80@$150; paper stock, $45@ $65; cement stock, $15@$25; floats, $7@$10, all per short ton, f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada.

Barytes—Crude, $6@$7 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $15@$17, f.o.b. Southern mills. Foreign barytes, f.o.b. New York, $28 per ton.

Bauxite — French bauxite, $8@$10 per metric ton, c.i.f. Atlantic ports. American bauxite, crushed and dried, $8@$10 per gross ton, f.o.b. shipping points; pulverized and dried, $12@$15 per gross ton, depending upon grade; calcined so as to remove most of the combined water, $20 per gross ton, f.o.b. shipping point.

Borax—Granulated, crystals, or powdered in bags, carloads, 5½c. per lb.; in bbls. 5¾c.

Chalk—English, extra light, 5c. Domestic light, 4½c.; heavy, 4c. per lb. all f.o.b. New York.

China Clay (Kaolin)—Crude, $6.50@$8.50; washed, $9@$10; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $12@$20, f.o.b. American ports; powdered, $25@$40, f.o.b., quoted at New York.

Emery—Turkish emery, 6c. per lb. Inferior grades, 3½c., f.o.b., from New England points.

Feldspar—No. 1 pottery grade, $6.50@$6.75 per long ton; No. 2 pottery, $5.75; No. 1 soap grade, $7.25@$7.50, f.o.b. cars. Most properties producing No. 2 pottery shut down or producing below capacity owing to bad roads.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$22.50 per ton, f.o.b. Illinois and Kentucky mines; gravel, $15; lump, $12.50, f.o.b. Lordsburg, N. M. Ground, acid grade, 97 per cent CaF_2, $30, New Mexico.

Fuller's Earth—16 to 30 mesh, $20 per ton; 30 to 60 mesh, $20; 60 to 100 mesh, $17; 100 mesh and over, $15, f.o.b. Pennsylvania points. Market quiet.

Graphite—Ceylon lump, first quality, 5½@6½c. per lb.; chip, 4@5c.; dust, 2½@3¾c.; No. 1 flake, 5@7c.; amorphous crude, $15@$42.50 per ton. All f.o.b. New York.

Gypsum—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1.40@$1.75 per net ton; 1½ in., $1.35@$1.70. Prices for other sizes practically the same. Agricultural limestone, $2.50@$4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined — Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $45@$50 in barrels, carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $53.80 per ton, f.o.b., Chester, Pa. (Magnesite brick—See Refractories.)

Mica — India block mica, slightly stained, per lb.: No. 6, 35c.; No. 5, $1.20; No. 4, $2.50@$3; No. 3, $3.50@$4; No. 2, $4.50@$6; No. 1, $5.50@$6.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York.

[1]Monazite — Minimum of 6 per cent thorium oxide, $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $11; 75 per cent, $9.50; 75@74 per cent, $9; 70 per cent, $6.25; 68 per cent, $5.75; 68@66 per cent, $5.50.

Pumice Stone — Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaport; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica — Glass sand, $2.25 per ton; sand-blast material, $2.25, both f.o.b. Indiana points. Amorphous or decomposed variety, soft silica, 250 to 500 mesh, $16@$30 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points. Market reported dull.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8.25@$13, f.o.b. points in Georgia; 200 mesh, $16@$20, f.o.b. Los Angeles.

Mineral Products

Copper Sulphate — Large crystals, 5.65c.; small crystals, 5.55c. per lb. f.o.b. New York.

Potassium Sulphate — Powder, domestic, 90c.@$1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate—$2.30 per cwt. ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $20@$22 per ton, New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 12c. per lb. of chromium contained; 4 to 6 per cent carbon, 13c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, $58@$60, f.o.b. furnace; resale, $90, delivered; English and German, $54@$58, c.i.f. Atlantic seaport. Spiegeleisen, 18@20 per cent, $25@$27 per gross ton, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.25 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $38@$40; 50 per cent, $57@$59; 75 per cent, $120@$125.

Ferrotungsten—Domestic, 70 to 80 per cent W, 40@45c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$4.25@$4.50 per lb. of V contained, according to analyses and quantity.

Metal Products

Copper Sheets—Current New York list price, 21.25c. per lb.; wire, 15@15.25c.

Lead Sheets—Full lead sheets, 7½c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver—29.50c. per lb. for 18 per cent nickel. Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.75c.; sheathing, 16.25c.; rods, ⅜ to 3 in., 14.75c.

Zinc Sheets—$8.50 per 100 lb., less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, $50 per ton; 76 per cent, $90@$95 f.o.b. works.

Chrome Brick—$43@$45 per net ton.

Chrome Cement — 40@45 per cent Cr_2O_3, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

Firebrick—First quality, 9-in. shapes, $28 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in. straights, $52@$55 per net ton, f.o.b. works.

Silica Brick—9-in., per 1,000, $28@$40 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, Jan. 2, 1922.

The steel market has been inactive the past week. Fundamental conditions have undergone no material variation in two or three months, and the market is not likely soon to change. In the past year the average decline in finished steel prices was approximately $22 per net ton. Under promise of a heavier operation, involving slightly lower costs, producers might shade present prices a trifle.

A few mills are closed temporarily. Production of ingots is at the rate of about 23,000,000 tons a year, equal to 44 per cent of capacity, which has increased by one-half since 1914 and has doubled since 1910.

Pig Iron—The market has continued extremely quiet. Bessemer remains quotable at $20, Valley, and foundry is $19.50. Basic iron, which has been quotable nominally at $19, is now quoted by merchant furnaces at $18.25, the merchant producers accepting as governing, a sale made two or three weeks ago by a steel works at this figure.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4.25@$4.50.

[1]Foote Mineral Co., Philadelphia, Pa.

COMPANY REPORTS

El Oro Declared Dividend and Bonus

A report of operations of the El Oro Mining & Railway Co., Ltd., for the year ended June 30, 1921, states that the net profit earned during this period was £74,383 3s. 6d. Out of this sum the directors declared dividend No. 31, of 5 per cent, or 1s. per share, tax free, for the year 1920 and 1921, which absorbed £57,375 0s. 0d., paid on Nov. 19, 1921.

During the year the directors decided to distribute a similar sum in a bonus dividend, No. 30, payable in shares of La Compania de Inversiones del Oro, S. A., equivalent in capital value to 1s. per share held by the shareholders of the El Oro Mining & Railway Co. This distribution has not yet been effected.

General and economic conditions in Mexico in the past year have shown improvement. In consequence, and in conjunction with further economies at the mine, due to extremely watchful management, working costs have been reduced by, roundly, $1[1] per ton. This has rendered it possible to maintain the average rate of profit per ton of ore, and at the same time to bring under treatment ore of correspondingly lower grade, which, under the conditions prevailing in the year preceding, would not have yielded a profit. The general result was that 383,043 tons of ore, having a gross value of $7.63 per ton, as treated in the reduction works, (compared with $8.77 for the previous year) produced bullion which realized $2,545,446, or $6.64 (compared with $7.61 for the pevious year) per ton, resulting in a net profit of $357,010, or £95,202 13s. 5d.

Profit and loss account follows:

Debit:

	£	s.	d.
Mining expenditures	583,305	11	6
Railway department expenditure	44,563	1	0
London expenses	2,546	3	2
Directors' fees	2,310	2	9
Depreciation of plant, machinery and investments	45,000	0	0
Provision for income tax and corporation profits tax	56,800	0	0
Balance carried to balance sheet	74,383	3	6
Total	£808,908	1	11

Credit:

	£	s.	d.
Bullion recovered	678,508	4	11
Railway department receipts	98,836	14	1
Interest and dividends	31,124	3	3
Sundry receipts	438	19	8
Total	£808,908	1	11

Balance at hand June 30, 1920, was £172,273 7s. 3d., less two dividends of £57,375 each plus profit for the year of £74,383 3s. 6d., which gives a balance on June 30, 1921, of £131,906 10s. 9d.

Costs per ton were: Mining, $2.38; development, $0.79; milling, $0.24; cyaniding $1.06; general expense, $0.32; taxes, $0.81; total, $5.66.

Ore reserves total 282,124 tons, estimated to contain $7.96 gold and 2.11 oz. silver per ton.

[1]American gold dollar. Exchange rate taken at $3.75 to £1.

Tonopah Belmont Development Co.

A condensed statement of operations of Tonopah Belmont Development Co. for the quarter ended Sept. 30, 1921, follows:

Received and receivable for ore	$489,822.78
Mining, milling and administration expenses	357,459.53
Net earnings for three months	$132,363.25
Miscellaneous income	1,482.43
Total net income for three months ended Sept. 30, 1921	$133,845.68
Available resources, Nov. 30, 1921 were:	
Due from smelters	$291,649.57
Due from others	56,168.98
Cash in banks	216,179.21
	$563,997.76

The net earnings for the quarter ended Sept. 30, 1921, of the Belmont Surf Inlet Mines, Ltd., of which this company owns 80 per cent, were $11,144.47.

Chile Copper Co. Shows Loss for Third Quarter

A report showing the results of the operations of Chile Exploration Co. for the third quarter of the year 1921 states copper output was 12,023,177 lb., compared with 12,001,873 lb., for the preceding quarter.

The cost of copper produced during the quarter was 11.405c. per lb., including selling and delivery expense, but excluding depreciation and Federal taxes and with no credit for miscellaneous income, compared with 11.971c. per lb. for the previous quarter.

The financial statement of the Chile Copper Co., and Chile Exploration Co. combined, (earnings being based on copper actually delivered) compares as follows:

	Third Quarter 1921	Second Quarter 1921
Pounds copper delivered	17,300,055	13,878,412
Net profit on copper delivered	$429,652.07	$291,667.31
Miscellaneous income	44,594.24	8,827.58
Interest on call loans and bank balances	86,055.87	122,883.19
Total income	$560,302.18	$423,378.08
Depreciation	$789,402.19	$697,249.54
Amortized discount on fifteen-year 6 per cent convertible bonds	35,000.00	35,000.00
Accrued bond interest of Chile Copper Co	787,500.00	787,500.00
Expenses of Chile Copper Co	8,280.00	13,661.92
Total charges	$1,620,182.19	$1,533,411.46
Balance undivided profits for quarter, both companies	(a)$1,059,880.01	(a)$1,110,033.38

(a) Loss.

It will be noted that of the above loss of $1,059,880.01, the sum of $789,402.19 is for depreciation, which is a book entry and is computed on a time basis, regardless of production or sale.

The companies had on Dec. 1, $8,586,000, representing cash on hand and marketable securities, after setting aside the amount required to complete payment of purchase price of the two tank ships mentioned in the last annual report.

Mining Dividends for December, 1921

The following dividends were paid by mining and metallurgical companies during December, 1921:

Companies of the United States	Situation	Per Share	Totals
American Smelting & Refining, pfd	U. S.	$.75 Q	$875,000
Calumet & Arizona, c	Ariz.	0.50 Q	321,260
Federal Mining & Smelting, pfd., s.l	Idaho	1.00 Q	120,000
Hecla Mining, s.l	Idaho	0.17 Q	170,000
Homestake Mining, g	S.D.	0.25 M	62,790
Iron Blossom Consolidated, s.c.l	Utah	0.025 I	25,000
National Lead, com	U. S.	1.50 Q	309,831
National Lead, pfd	U. S.	1.75 Q	426,433
St. Joseph Lead	Mo.	0.25 Q	352,367
St. Mary's Mineral Land, c	Mich.	1.00 I	160,000
Texas Gulf Sulphur	Texas	1.00 X	635,000
United Verde Copper	Ariz.	1.50 Q	450,000
Utah Copper	Utah	0.50 Q	812,245
Companies in Canada			
Hollinger Consolidated Gold	Ont.	0.10	492,000

Q, quarterly; M, monthly; I, irregularly; X, includes extra; c, copper; s silver; l, lead; g, gold.

The showing is slightly improved over that of three months ago. Hecla increased its dividend from 10 to 17c. Iron Blossom Consolidated appears for the first time since January, 1920, with the then customary dividend of 2½c. St. Mary's Mineral Land paid its only dividend of the year, $1, half of the 1920 distribution. Texas Gulf Sulphur paid an initial dividend of 50c. with 50c. more as an extra. This company was only recently listed on the New York Stock Exchange, quotations rising from 32⅝ on Dec. 1 to 42⅛ on Dec. 28. Two of the Hollinger payments, which are made every four weeks, came in December, on the second and thirty-first. The 2½c. dividend of the Rochester Silver Corporation is missing from the list, but will be paid in January.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1920	1921	1920	1921	1920	1921
January	132.827	65.950	79.846	39.985	367.082	372.650
February	131.295	59.233	85.005	34.745	337.466	385.932
March	125.551	56.023	74.194	32.479	370.870	389.806
April	119.779	59.337	68.848	34.250	392.438	391.784
May	102.585	59.810	60.010	34.165	383.360	396.580
June	90.957	58.510	51.096	34.971	393.663	377.236
July	91.971	60.260	53.736	37.481	385.538	362.565
August	96.168	61.597	59.875	38.096	360.404	364.505
September	93.675	66.160	59.476	40.082	350.370	371.725
October	83.480	70.970	54.197	41.442	346.460	386.315
November	77.734	68.234	50.952	38.750	342.333	396.315
December	64.774	65.760	41.845	35.645	348.101	414.880
Year	100.900	62.654	61.590	36.841	364.840	384.191

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1920	1921	1920	1921	1920	1921
January	18.918	12.597	118.095	70.964	123.238	79.119
February	18.569	12.556	120.188	70.925	126.950	75.925
March	18.331	11.976	109.533	67.565	118.348	71.190
April	18.660	12.438	103.025	69.381	111.500	71.786
May	18.484	12.742	96.750	73.196	109.200	74.298
June	18.065	12.697	87.864	71.852	101.909	75.682
July	18.576	12.170	90.148	71.155	106.455	75.286
August	18.346	11.634	93.935	68.614	111.143	72.705
September	18.144	11.948	96.381	67.977	111.905	72.295
October	15.934	12.673	93.327	67.327	104.905	73.476
November	14.257	13.035	84.807	66.614	94.614	74.386
December	13.188	13.555	75.702	66.706	85.905	74.525
Year	17.456	12.502	97.480	69.356	108.839	74.223

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1920	1921	1920	1921	1920	1921
January	8.561	4.821	8.300	4.747	47.095	23.387
February	8.814	4.373	8.601	4.228	50.256	20.650
March	9.145	4.084	8.894	4.000	46.054	18.911
April	8.902	4.356	8.618	4.272	39.225	20.589
May	8.576	4.952	8.352	4.784	38.488	23.399
June	8.323	4.485	8.169	4.293	34.330	22.563
July	8.338	4.410	8.283	4.260	34.960	23.399
August	8.687	4.382	8.725	4.217	36.304	23.489
September	8.177	4.600	8.160	4.392	35.452	23.148
October	7.070	4.690	7.018	4.439	35 238	23.679
November	6.159	4.683	6.127	4.356	32.489	24.483
December	4.727	4.700	4.717	4.369	24.089	25.322
Year	7.957	4.545	7.830	4.363	37.832	22.752

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1920	1921	1920	1921	1920	1921
January	61.596	31.470	.....	36.000	376.512	198.464
February	58.466	28.534	59.932	32.142	395.750	166.250
March	61.037	27.296	61.926	28.806	369.489	156.024
April	61.120	28.990	62.115	30.404	345.450	163.905
May	53.230	31.431	55.100	32.500	294.813	177.411
June	46.125	28.514	48.327	29.423	250.614	167.506
July	45.798	26.755	49.154	27.655	261.886	164.530
August	43.856	25.662	47.620	26.301	274.048	155.318
September	41.940	26.280	44.465	26.680	270.120	156.750
October	39.310	27.278	40.555	27.655	258.190	156.380
November	35.667	28.592	36.854	28.935	241.080	158.898
December	31.135	32.106	34.058	32.486	212.440	169.738
Year	48.273	28.576	49.101	29.916	295.866	165.265

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1920	1921	1920	1921
January	9.133	5.413	58.643	25.262
February	8.708	4.928	61.338	24.850
March	8.531	4.737	53.467	25.077
April	8.184	4.747	47.388	25.530
May	7.588	4.848	45.088	26.923
June	7.465	4.421	41.193	26.750
July	7.720	4.239	41.886	26.262
August	7.835	4 186	41.220	25 068
September	7.661	4 235	39.690	25.256
October	7.150	4.605	39.756	26.315
November	6.247	4 665	35.028	25.949
December	5.824	4.837	27.762	26.900
Year	7.671	4.655	44.372	25.845

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1920	1921	1920	1921	1920	1921
January	10.577	5.258	90.192	48.440	154.23	73.400
February	11.588	5.250	84.432	49.545	151.59	70.227
March	11.056	5.282	92.611	46.796	138.56	72.465
April	10.500	5.137	102.192	45.423	127.04	73.404
May	9.655	5.250	89.560	47.000	97.50	73.740
June	8.289	5.067	90.154	46.846	85.19	74.942
July	7.500	4.735	90.333	44.950	83.94	70.440
August	7.177	4.597	83.806	45.028	111.44	73.222
September	7.113	4.564	75.000	42.660	115.20	75.968
October	6.723	5.085	67.200	39.840	101.70	81.800
November	6.109	4.734	58.417	39.804	84.75	82.689
December	5.534	4.500	49.577	49.212	79.62	78.192
Year	8.485	4.957	81.123	45.462	110.90	75.033

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1920	1921	1920	1921	1920	1921
January	$40.47	33.96	$39.88	31.96	$39.86	33.88
February	42.95	28.96	42.61	26.96	43.40	30.25
March	43.40	28.16	42.90	26.46	43.40	27.85
April	43.72	26.96	44.22	24.46	43.90	26.77
May	44.00	26.21	44.88	23.84	45.36	25.56
June	44.89	24.96	45.41	22.66	46.40	24.38
July	47.21	22.84	47.42	20.76	46.56	22.36
August	48.90	21.96	49.88	20.29	49.35	21.53
September	50.46	21.96	50.46	21.21	51.96	22.82
October	49.21	21.96	44.38	20.96	48.58	22.96
November	41.26	21.96	39.20	20.96	42.61	22.74
December	36.96	21.96	34.90	20.65	37.73	21.96
Year	44.45	25.15	43.85	23.43	44.93	25.26

In dollars per long ton.

Monthly Crude Copper Production

	1921			
	August	September	October	November
Alaska shipments	4,407,434	3,709,844	6,160,847	4,841,506
Arizona Copper	(a)	(a)	(a)	(a)
Calumet & Arizona	(a)	(a)	(a)	(a)
Con. Ariz. Smelting	(a)	(a)	(a)	(a)
Inspiration	(a)	(a)	(a)	(a)
Magma	(a)	(a)	(a)	(a)
Miami	4,281,000	4,268,000	5,084,000	4,514,000
New Cornelia	1,511,964	1,527,493	1,536,725	1,605,936
Old Dominion	(a)	(a)	(a)	(a)
Phelps Dodge	(a)	(a)	(a)	(a)
Shattuck Arizona	(a)	(a)	(a)	(a)
Ray	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	(a)	(a)	(a)
Calumet & Hecla	(a)	(a)	(a)	(a)
Other Lake Superior	4,250,000	4,250,000	4,250,000	5,500,000
Anaconda	(a)	(a)	(a)	(a)
East Butte	1,278,000	949,980	1,000,000	750,000
Nevada Cons	(a)	(a)	(a)	(a)
Chino	(a)	(a)	(a)	(a)
Utah Copper	(a)	(a)	(a)	(a)
Others, estimated	7,520,000	9,150,000	5,200,000	11,130,000
Total United States	23,248,398	23,855,317	23,231,572	28,341,442
Imports: Ore and concentrates, matte, etc	10,888,426	6,268,635	8,445,551	7,297,583
Imports of blister, unrefined	12,574,740	8,614,851	23,360,893	10,561,454
Imports of refined, etc	662,885	10,553,792	761,125	2,139,144
Grand total	47,374,449	49,292,595	55,799,141	49,339,623
Granby Cons	2,485,704	2,720,761	2,593,250	2,365,017
Boleo	770,096	771,305	1,041,863	976,815
Cananea	(a)	(a)	(a)	(a)
Phelps Dodge Mexican	(a)	(a)	(a)	(a)
Cerro de Pasco	4,630,000	4,594,000	5,330,000	5,618,000
Chile	4,000,000	4,000,000	4,000,000	4,000,000
Katanga	6,509,160	6,136,515	6,189,435	5,984,370
Backus & Johnston	720,000	350,000	198,000	900,000
Hampden Cloncurry	(a)	(a)	(a)	(a)
Mount Lyell	940,000	1,204,000	1,220,000	.....
Mount Morgan	(a)	(a)	(a)	(a)
Cons. M. & S. of Canada	209,090	261,855	156,940	200,000
Falcon Mines	540,880	511,280	550,710	518,600
Furukawa	2,580,453	2,744,371	2,541,508	.....
Sumitomo	1,673,601	1,674,865	1,444,316	2,910,964

(a) No copper produced during this month.

Comparative Annual Copper Production

	1919	1920	1921
January	135,733,511	121,903,744	90,596,597
February	111,649,512	117,450,000	86,682,941
March	102,040,460	120,309,316	91,046,345
April	98,808,998	116,078,871	46,946,523
May	92,652,975	114,964,207	25,310,511
June	95,856,570	116,107,856	24,623,693
July	100,369,247	109,729,610	22,033,739
August	107,994,040	112,460,254	23,248,398
September	108,703,075	104,9195,62	23,855,316
October	115,143,143	105,231,571	23,231,572
November	117,289,735	106,700,178	28,341,442
December	102,997,633	95,709,009	.....

MINING STOCKS

Week Ended December 31, 1921

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	62	60	62	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	2⅛	2⅛	2⅛		
Allouez	Boston	24	23	24	Mar. '19	1.00
Anaconda	New York	50¼	49⅛	49⅛	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3	3	3		
Ariz. Com'l	Boston	9	8⅞	9	Oct. '18, Q	.50
Big Ledge	N. Y. Curb	*28	*25	*25		
Bingham Mines	Boston	†13½	†12⅛	13	Sept. '19, Q	.25
Calumet & Arizona	Boston	59	58	59	Dec. '21 Q	.50
Calumet & Hecla	Boston	280	270	270	June '20, Q	5.00
Canada Copper	N. Y. Curb	*38	*36	*38		
Centennial	Boston	10	9⅛	9⅛	Dec. '18, SA	1.00
Cerro de Pasco	New York	35⅛	34⅛	34⅛	Mar. '21, Q	.50
Chile Copper	New York	16⅛	15⅛	15⅛		
Chino	New York	28⅛	27	28	Sept. '20, Q	.37½
Columbus Rexall	Salt Lake	†*12	†*11½	†*11½		
Con. Arizona	N. Y. Curb	*4	*3	*3	Dec. '18, Q	.05
Con. Copper Mines	N. Y. Curb	1⅛	1⅛	1 1/16		
Copper Range	Boston	39½	38⅛	38⅛	Sept. '20, Q	.50
Crystal Copper	Boston Curb	*65	*55	*64		
Davis-Daly	Boston	7	6⅛	6⅛	Mar. '20, Q	.25
East Butte	Boston	11⅛	10⅛	11	Dec. '19, A	.50
First National	Boston Curb	*80	*75	*75	Feb. '19, SA	.15
Franklin	Boston	1⅛	1⅛	1⅛		
Gadsden Copper	Boston Curb	*50	*50	*50		
Granby Consol.	New York	29	28⅛	28⅛	May '19, Q	1.25
Greene- Cananea	New York	28⅛	27⅛	27⅛	Nov. '20, Q	.50
Hancock	Boston	2⅛	2	2		
Howe Sound	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '21, Q	.05
Inspiration Consol.	New York	41⅛	40	40⅛	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7⅛	7⅛	7⅛	Sept. '20, K	.25
Isle Royale	Boston	24⅛	23	23⅛	Sept. '19, SA	.50
Kennecott	New York	27⅛	26⅛	26⅛	Dec. '20, Q	.50
Keweenaw	Boston	1⅛	1	1⅛		
Lake Copper	Boston	2⅛	2⅛	2⅛		
La Salle	Boston	2	1⅛	1⅛		
Magma Chief	N. Y. Curb	....	....	*8		
Magma Copper	N. Y. Curb	28	25⅛	28	Jan. '19, Q	.50
Majestic	Boston Curb	*4	*2	*4		
Mason Valley	Boston	1⅛	1⅛	1⅛		
Mass Consolidated	Boston	3	2⅛	2⅛	Nov. '17, Q	1.00
Miami Copper	New York	27⅛	26⅛	27⅛	Nov. '21, Q	.50
Michigan	Boston	2	1⅛	2		
Mohawk	Boston	57⅛	54⅛	54⅛	Nov. '20, Q	1.00
Mother Lode Coa.	N. Y. Curb	7⅛	5⅛	7⅛		
Nevada Consol.	New York	15⅛	14⅛	14⅛	Sept. '20, Q	.25
New Cornelia	Boston	18⅛	17⅛	17⅛	Aug. '20, K	.25
North Butte	Boston	13⅛	12⅛	12⅛	Oct. '18, Q	.25
North Lake	Boston	†*40	†*20	*24		
Ohio Copper	N. Y. Curb	*11	*8	*8		
Old Dominion	Boston	25	23	23	Dec. '18, Q	1.00
Osceola	Boston	33⅛	32	32	June '20, Q	.50
Phelps Dodge	Open Mar.	†185	†175	....	Oct. '21, Q	1.00
Quincy	Boston	45	43	43	Mar. '20, Q	1.00
Ray Consolidated	New York	15⅛	14⅛	15⅛	Dec. '20, Q	.25
Ray Hercules	N. Y. Curb	*15	*12	*12		
St. Mary's Min. Ld.	Boston	45	43	43	Dec. '21, K	1.00
Seneca Copper	Boston	....	....	24⅛		
Shannon	Boston	1⅛	1	1	Nov. '17, Q	.25
Shattuck Arizona	New York	8⅛	8	8⅛	Jan. '20, Q	.25
South Lake	Boston	†1	†*55	*60		
Superior & Boston	Boston	1⅛	1⅛	1⅛		
Tenn. C. & C. cfs.	New York	10⅛	10	10	May '18, I	1.00
Tuolumne	Boston	*67	*60	*65	May '13	.10
United Verde Ex.	Boston Curb	30	28⅛	29⅛	Nov. 21, Q	.25
Utah Consol.	Boston	2	1⅛	1⅛	Sept. '18,	.25
Utah Copper	New York	65⅛	62⅛	63⅛	Dec, '21 Q	.50
Utah Metal & T.	Boston	1⅛	1⅛	1⅛	Dec. '17,	.30
Victoria	Boston	†1⅛	†1⅛	1⅛		
Winona	Boston	*35	*35	*35		
Wolverine	Boston	11⅛	11	11		
NICKEL-COPPER						
Internat. Nickel	New York	12⅛	11⅛	12	Mar. '19,	.50
Internat. Nickel, pf.	New York	67⅛	60	65	Nov. '21, Q	1.50
LEAD						
National Lead	New York	87	83⅛	87	Dec. '21, Q	1.50
National Lead, pfd.	New York	108	107⅛	108	Dec. '21, Q	1.75
St. Joseph Lead	New York	13⅛	12⅛	12⅛	Dec. '21, Q	.25
QUICKSILVER						
New Idria	Boston	1⅛	*50	1		
ZINC						
Am. Z. L. & S.	New York	14⅛	12⅛	13⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	38	36	36	Nov. '20, Q	1.50
Butte C. & Z.	New York	6	5⅛	5⅛	June '18,	.50
Butte & Superior	New York	22⅛	20⅛	22	Sept. '20,	1.25
Callahan Zn-Ld.	New York	6⅛	5⅛	5⅛	Dec. '20, Q	.50
New Jersey Zn.	N. Y. Curb	125	124⅛	125	Nov. '21 Q	2.00
Yellow Pine	Los Angeles	*48	*45	*47	Sept. '20, Q	.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

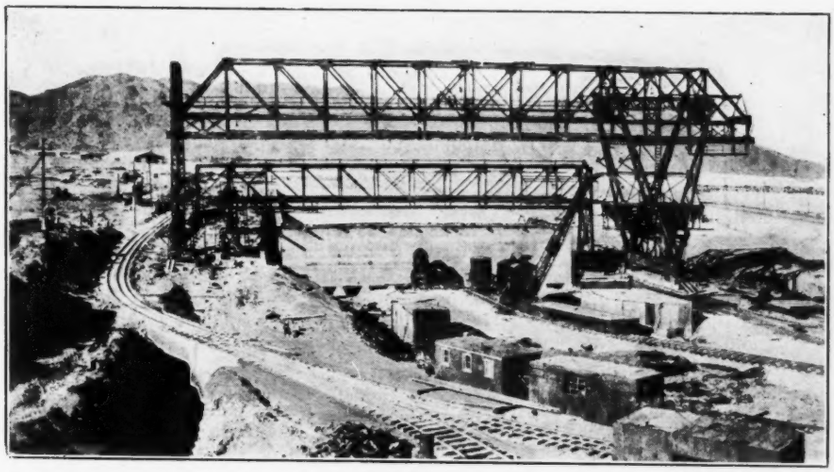
Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	⅛	⅛	⅛		
Carson Hill	New York	11⅛	11	11⅛		
Cresson Consol. G.	N. Y. Curb	2⅛	2 1/16	2⅛	June '20, Q	$0.10
Dome Extension	Toronto	*69	*69	*69		
Dome Mines	New York	19	18⅛	19	Oct. '21, Q	.25
Florence Goldfield	N.Y. Curb	*30	*26	*26		
Golden Cycle	Colo. Springs	*70	*66½	*62½	June '21, Q	.02
Goldfield Consol.	N. Y. Curb	*4	*3	*4	Dec. '19,	.05
Hollinger Consol.	Toronto	7.75	7.70	7.72	Dec. '21, 4 wks.	.05
Homestake Mining	New York	55	53½	55	Dec. '21, M	.25
Kirkland Lake	Toronto	*30	*27	*30		
Lake Shore	Toronto	1.34	1.25	1.34	Nov. '21, K	.02
McIntyre-Porcupine	Toronto	2.12	2.00	2.12	Sept. '21, K	.05
Porcupine Crown	Toronto	*13⅛	*10⅛	*11⅛	July '17,	.03
Porcupine V. N. T.	Toronto	*18	*17½	*17½		
Portland	Colo. Springs	*40	*40	*40	Oct. '20, Q	.01
Schumacher	Toronto	*31	*30	*31		
Silver Pick	N. Y. Curb	....	....	*50		
Teck Hughes	Toronto	*15½	*14⅛	*15½		
Tom Reed	Los Angeles	*40	*36	*38	Dec. '19,	.02
United Eastern	N. Y. Curb	2 1/16	2 1/16	2 1/16	Oct. '21, Q	.15
Vindicator Consol.	Colo. Springs	*21	*19½	*19½	Jan. '20, Q	.01
White Caps Mining	N. Y. Curb	*5	*3	*5		
Yukon Gold	N. Y. Curb	1 1/16	1	1 1/16	June '18,	.02½
SILVER						
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	.12½
Beaver Consol.	Toronto	*20	*16⅛	*18	May '20, K	.03
Coniagas	Toronto	1.50	1.30	1.50	May '21, Q	.12½
Crown Reserve	Toronto	*10	*8	*8	Jan. '17,	.05
Kerr Lake	N. Y. Curb	3⅛	3⅛	3⅛	Oct. '21, Q	.12½
La Rose	Toronto	*34½	*32½	*34	Apr. '18,	.02
McKinley-Dar.-Sav.	Toronto	*14½	*14	*14	Oct. '20, Q	.03
Mining Corp. Can.	Toronto	1.15	1.00	1.15	Sept. '20, Q	.12½
Nipissing	N. Y. Curb	7	6⅛	6⅛	Oct. '21, Q	.03
Ontario Silver	New York	4⅛	4	4	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	....	....	*12	Jan. '12,	.10
Temiskaming	Toronto	*26	*25	*25	Jan. '20, K	.04
Trethewey	Toronto	*8	*5⅛	*5⅛	Jan. '19,	.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*91	*85	*87		
Cash Boy	N. Y. Curb	*5	*5	*5		
Dolores Esperanza	N. Y. Curb	1	*75	1		
El Salvador	N. Y. Curb	*6	*3	*4		
Jim Butler	N. Y. Curb	*6	*6	*6	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*3	*3	*3	June '16,	.05
Louisiana Con.	N. Y. Curb	....	....	⅛		
MacNamara M.& M.	N. Y. Curb	*10	*4	*8	May '10,	.02½
Tonopah-Belmont	N. Y. Curb	1⅛	1⅛	1⅛	Apr. '21, Q	.05
Tonopah-Divide	N. Y. Curb	*67	*60	*65		
Tonopah-Extension	N. Y. Curb	1⅛	1 1/16	1 1/16	Oct. '21, Q	.05
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1⅛	Oct. '21, SA	.05
West End Consol.	N. Y. Curb	*80	*75	*75	Dec. '19, SA	.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*6	*5	*6	Jan. '21, M	.01
Cardiff M. & M.	Salt Lake	†*92	†*85	*92	Dec. '20,	.15
Chief Consol.	Boston Curb	3⅛	3	3	Aug. '21, Q	.05
Consol. M. & S.	Montreal	18⅛	18⅛	18⅛	Oct. '20, Q	.62½
Daly Mining	Salt Lake	†3.00	†1.00	....	July '20, Q	.10
Daly-West	Boston	†3⅛	†1⅛	2	Dec. '20, Q	.25
Eagle & Blue Bell	Boston Curb	2⅛	2⅛	2⅛	Apr. '21, K	.05
Electric Point	Spokane	*4	*4	*4	May '20, SA	.03
Federal M. & S.	New York	....	....	10	Jan. '09,	1.50
Federal M. & S., pfd	New York	39⅛	38⅛	39	Dec. '21, Q	1.00
Florence Silver	Spokane	*19½	*19½	*19½	Apr. '19,	.01½
Grand Central	Salt Lake	†*45	†*41	*41	Jan. '21, K	.01
Hecla Mining	N. Y. Curb	4⅛	4⅛	4⅛	Dec. '21, Q	.17
Iron Blossom Con.	N. Y. Curb	*53	*28	*30	Dec. '21, Q	.02½
Judge M. & S.	Salt Lake	†3.00	†2.00	2.50	Sept. '20, Q	.12½
Marsh Mines	N. Y. Curb	*4	*4	*4	June '21, I	.02
Prince Consol.	Salt Lake	*7⅛	*7⅛	*7⅛	Nov. '17,	.02½
Rambler-Cariboo	Spokane	*4	*4	*4	Feb. '19,	.01
Rex Consol.	N. Y. Curb	*8	*7	*7		
South Hecla	Salt Lake	....	†*12½	....	Sept. '19, K	.15
Standard Silver-Ld.	N. Y. Curb	*10	*10	*10	Oct. '17,	.05
Stewart Mining	N. Y. Curb	*2	*1	*1	Dec. '15	.05
Tamarack-Custer	Spokane	2.27	2.20	2.22	Jan. '21 K	.04
Tintic Standard	Salt Lake	1.87½	1.80	1.80	July '21, Q	.05
Utah Apex	Boston	3	2⅛	3	Nov. '20, K	.25
Wilbert Mining	N. Y. Curb	*1	*1	*1	Nov. '17,	.01
VANADIUM						
Vanadium Corp.	New York	32⅛	31	31⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	50	50	50	Oct. '21, Q	1.50
Asbestos Corp., pfd.	Montreal	....	....	77	Oct. '21, Q	1.75
SULPHUR						
Freeport, Texas	New York	14⅛	13⅛	13⅛	Nov. '19, Q	1.00
Texas Gulf	New York	42	39	41	Dec. '21, Q	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	46⅛	44	45⅛	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf	New York	87⅛	86⅛	86⅛	Dec. '21, Q	1.75
Am. Sm. pf. A	New York	....	....	87⅛	Oct. '21, Q	1.50
U. S. Sm. R. & M.	New York	38⅛	36	36	Jan. '21, Q	.50
U.S.Sm.R.& M. pf.	New York	45	44	45	Oct. '21, Q	.87½

NEW MACHINERY AND INVENTIONS

An Ore Unloading Bridge in Chile

An accompanying illustration shows the ore unloading bridge used by the Chile Exploration Co. at their Chuquicamata plant for unloading leached tailings from three 10,000-ton capacity leaching vats into railroad cars. The bridge is electrically operated and is



ORE UNLOADING BRIDGE THAT HANDLES 10,000 TONS IN SIXTEEN HOURS

equipped with a trolley-operated grab bucket of 12 gross tons capacity.

The leaching vats are 150 ft. in length, 110 ft. wide and 20 ft. deep. The runways for the bridge extend along the sides so that the bridge commands the total area of all the vats. The grab bucket deposits the material in hoppers on the main tower of the bridge, from which it flows by gravity into the side-dump railroad cars and is hauled to the tailings dump. It is possible to unload the vats at the rate of 10,000 tons in sixteen hours.

The bridge traverses at a rate of 75 ft. per minute and the motor is equipped with a powerful magnetic solenoid brake capable of locking all of the wheels connected with the driving mechanism to the rail when the bridge is not in motion. The equipment is of Wellman-Seaver-Morgan Co. manufacture.

Novel Use of Flood Light Projector

Recently the Eagle-Picher Lead Co. made extensive improvements at their oxide works at Galena, Kan., and among other things had built a concrete stack 257 ft. in height to carry off fumes from their "bag room." The stack, when put into use, was found to serve its purpose admirably, but an unforeseen difficulty developed, which for a time threatened to materially cut down the efficiency of the plant.

In the process of separating the oxide from the gases, it frequently happens that one or more bags become unfastened from their shackles, thereby permitting the valuable byproduct to escape to and out of the stack. In order to detect such disarrangement of bags, frequent observations of the mouth of the stack are made and if a whitish haze is seen to emerge therefrom, it is evident that something is not right in the bag room. An attendant, protected by gas mask, enters the chamber, makes whatever adjustment may be necessary and then returns.

During daylight hours, it is a simple matter to detect the escape of oxide, but at night suitable illumination must be provided to show that all is well or otherwise in the bag room. In building the stack no provision had been made for such lighting, and owing to the height of the structure it was deemed impracticable to equip and maintain a scheme of illumination. After vainly trying out various schemes, which proved unsuccessful or unsatisfactory, the management appealed to the Empire District Electric Co. at Joplin, from whose lines the plant is supplied with power and light, and asked their engineers to recommend a plan to illuminate the mouth of the stack.

The logical method of providing the desired illumination was found to be a beam of light directed to the top of the stack from some vantage point in its vicinity. For various reasons, the management would not consent to having the source of light placed on the building in which the bag room is located and it was necessary to mount a projector on a low storage building about 150 ft. from the base of the stack. This necessitated a "throw" of about 325 ft., requiring a highly efficient reflector of concentrated beam. After studying the characteristics of several projectors, it was decided to specify a National X-Ray No. 60, equipped with reflector No. 840, for use with 500 watt flood lamp.

This unit was ordered and installed as directed and was found to give entirely adequate intensity at the tip of the stack and the lead company management expressed themselves as very well pleased with the result.

Fines Are Rapidly Removed in New Coal Pulverizing Machine

A new machine, known as the "Pulver-burner," which is used for the preparation of powered coal, has recently been placed on the market. The essential features of the machine, which is fed by an automatic feeder of the belt type, are the pulverizing mechanism and the air separating chamber.

The pulverizing is accomplished by means of six rapidly revolving hinged beaters, which smash the coal against breaking blocks and then against grinding plates in the bottom of the machine. The pulverulent material is discharged by centrifugal force directly into a large separating chamber. An exhaust fan, in the discharge duct leading from the separating chamber, induces air at slow velocity through the chamber, removing the fine coal and allowing the oversize to return to the machine for further pulverization. It is apparent that the velocity of the air through the separating chamber determines the fineness of the product. From the separating chamber, the fine dust is drawn through the fan and blown directly into the furnace. Secondary air is added at the nozzle. By using "splitters," the stream of coal and air can be distributed to several nozzles, thus enabling one machine to serve several furnaces.

By combining impact pulverization with air separation, many advantageous features are obtained. The "fines" are removed from the machine as rapidly as produced, so that the beaters are always operating on coarse material. This is an important item of power saving, even though impact pulverizing is known for its low power requirements.

Coal that has not been dried can be successfully handled in this type of mill, and, because of the air separator, there are no screens to clog.

For efficient powdered-coal burning, close regulation is necessary, and this has been provided for in the "Pulver-burner." The rate at which the coal is fed is controlled by the automatic feeder by means of a cam arrangement that varies the speed of the belt. (The coal should be fed in such a size that a uniform "ribbon" is formed on the belt. Coal of 1 in. and under is satisfactory.) A magnetic pulley can be used with the feeder to prevent tramp iron from entering the machine. The quantity of air is controlled either by the speed of the fan, if a variable speed motor be used, or by a damper in the discharge passage. Air is introduced around the shaft. Velocity of the air through the separating chamber is regulated by two vanes in the chamber which are controlled through a worm and wheel.

The entire controlling mechanism can be operated by an automatic regulator. The apparatus is designed to be driven by either one, two or three motors. If one motor is used, both fan and feeder are driven from the pulverizer shaft. It is sometimes desirable to drive the

fan from a separate motor; likewise the feeder.

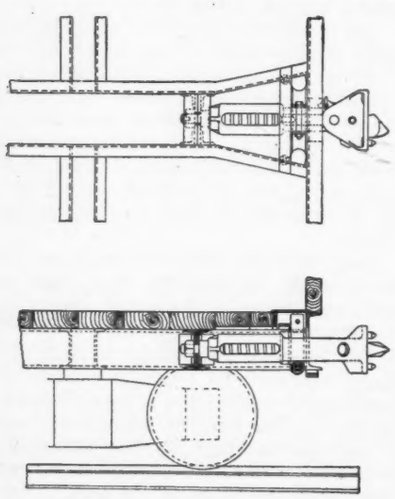
The advantages claimed for the machine are its compactness, close regulation of fineness and air, simplicity, economy and adaptability to small as well as large installations. It is being built in capacities up to three tons per hour.

The K. B. Pulverizer Co., 92 Lafayette St., New York, is the manufacturer.

Automatic Couplers for Mine Cars

The automatic coupling of cars in mine haulage is a subject which is beginning to receive the attention its importance has long merited. The same considerations which dictated the adoption of automatic couplers on trains in surface operation apply with equal if not greater force to trains running under ground. Safety to operators, increased flexibility of train movements and reduction of time required in distributing and collecting cars are all items of vital importance to the modern mine management.

The conditions obtaining in mines are admittedly severe for the coupler designer, particularly in old workings where small cars and extremely short



AUTOMATIC COUPLER FOR MINE CAR

radius track curves are frequently encountered. There are few cases however that will not yield to a careful study of conditions and appropriate design.

The Ohio Brass Co., Mansfield, Ohio, which has for many years been a foremost manufacturer of automatic couplers for all classes of electric railway service, has designed special mine car couplers for several large operators and is well equipped through its long experience in coupler production to give expert engineering service in connection with these later types of mine couplers.

The illustration shows an automatic coupler mounted upon a large modern double truck mine car. The coupler is equipped with heavy draft spring and has a spring carrier, or yielding support, which maintains the coupler head at proper elevation and in the necessary central position. Information concerning this and other types of coupler equipment will be supplied upon request.

INDUSTRIAL NOTES

The Boston office of the Cutler-Hammer Mfg. Co., Milwaukee, has been moved from the Columbian Life Bldg. to Rooms 403 and 404 Harvey Building, Chancey St. C. W. Yerger is manager of this office.

I. C. van Itallie Co., 90 West Broadway, New York, have been appointed the exclusive selling agents for Messrs. J. K. Smit & Zonen of Amsterdam, Holland, high grade industrial diamonds (carbons and borts).

Combustion Engineering Corporation, Broad St., New York, have opened a new branch office at 806 First National Bank Building, Pittsburgh, Pa. This office will be in charge of W. C. Stripe, formerly manager of the Philadelphia office.

The Osgood Co., Marion, Ohio, announces the opening of a branch sales office at 1211 Conway Building, Chicago, Ill., which will be in charge of Arthur B. Sonneborn, as manager.

The New York office of the Blaw-Knox Co. has moved from the City Investing Building to the Carbide & Carbon Building, 30 East 42d St.

Whiting Corporation, Harvey, Ill., has purchased a controlling interest in the Grindle Fuel Equipment Co., manufacturers of complete powdered coal plants for use in connection with malleable furnaces, annealing ovens, steam boilers, billet heating and various other types of furnaces. The Grindle Fuel Equipment Co. has moved its offices to Harvey, Ill., and will continue its business under the same name.

Announcement is made of the retirement, effective in January, of A. P. Van Gelder, general superintendent of high explosives plants, Hercules Powder Co., from the active ranks of the organization. Following Mr. Van Gelder's decision to retire, several changes have been made in the operating organization of the Hercules company, all of which will take effect the first of the year. L. N. Bent will assume the duties and title of assistant general manager in charge of miscellaneous manufacture and C. A. Bigelow, formerly general manager of the Aetna Explosives Co., Inc., will be assistant general manager in charge of high explosives manufacture. F. P. H. Sholly, who came with the Hercules company through the purchase of the Aetna company, has been transferred from the operating to the purchasing department and will be an assisting purchasing agent.

TRADE CATALOGS

Mine Locomotives—Atlas Car & Mfg. Co., Cleveland, Ohio, recently issued Bulletin No. 1212, descriptive of combination storage battery and trolley locomotives.

Tractor Crane — Industrial Works, Bay City, Mich., is distributing free upon request Catalog No. 113, illustrating and describing the Type BC "Industrial" crawling tractor crane of 20,000 lb. capacity.

Pump Data—The Aldrich Pump Co., Allentown, Pa., have issued an 18-page pamphlet which contains engineering tables relative to pumps. It is seldom that such data are arranged so conveniently in a publication of this sort, and the tables and other information will be found invaluable to the mine operator and engineer.

Oil Engines—Information regarding oil engines of the surface ignition type is reviewed in detail in a book, "Oil Engines," recently issued by the Vacuum Oil Co., New York. Construction, operation, fuel, methods of lubrication, lubricating oils, and deposits are included in the topics covered. The book is well illustrated with colored diagrams which show operation in an excellent manner.

Screens—Bulletin No. 10 of The Simplex Screen Co., Felt Building, Salt Lake City, Utah, describes and illustrates the Simplex screen which consists of a plurality of bars mounted in a frame. To each bar is secured a series of screening teeth, the free ends of the teeth of each bar resting on the next bar below. The screen surface resembles a series of combs with each alternate tooth of each comb offset.

Gasolene-Electric Shovel—The Marion Steam Shovel Co., Marion, Ohio, have recently placed a newly designed gasoline-electric shovel on the market. The machine is applicable in stone quarries, lime and cement plants, clay pits and open mines where boiler feed water as a rule contains a high percentage of mineral or vegetable matter; also in the oil producing sections of the Southwest and in the many localities where steam is impractical. This new shovel is described in a 4-page folder issued by the Marion Steam Shovel Co.

Wire Rope — "Outspinning the Spider" is the title of an attractive book recently published by Robert L. Stillson Co., New York. The author, John Kimberly Mumford, who has written a number of books on industrial subjects, tells for the first time the history of wire-rope making in this country, from the beginning of the industry in 1840 by the John A. Roebling Sons Co., Trenton, N. J. "Outspinning the Spider" relates the romance of the Brooklyn Bridge, of the wire rope barrage laid down in the English Channel during the late war, and other interesting engineering achievements.